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The Annual Meeting

WHAT was the 1922 Annual Meeting? It was the culmination of another year of constructive effort on the part of all automotive engineers. It was proof that the prediction made last year to the effect that automotive engineers would play their full part in the effort to restore that proper economic balance which is essential to national prosperity had come true. Further, it was a demonstration of what cooperative effort on a large scale can accomplish. From the opening of the Standards Committee Meeting on Tuesday morning, Jan. 10, to the end of the Passenger-Car Session on Friday afternoon, Jan. 13, the period of all the technical and social activities of the week, the evidence was cumulative and conclusive, as demonstrated by the quality, scope and subject matter of the papers presented, that the serious painstaking work of automotive engineers during the past 12 months had resulted in something worthwhile, something well worthwhile, something that they and others can use as a stepping-stone to further progress and therefore something that will benefit humanity.

When one considers the exigencies of modern life, its exorbitant demands upon an individual's time, his money, his physical and nervous energy, what does it mean when a single industry can send nearly 800 representative members to spend a week at some central point for the express purpose of reporting upon standardization, research and experimental work, and to outline and correlate future plans for progress? This is what the automotive industry did in this particular instance. It means that members of the Society realize the economic importance of their work, that its demands for progress are so insistent as to permit of no delay, and that they, and those who could not attend, are willing and anxious to subordinate their personal affairs to general cooperative effort that is certain to produce general and good results.

Few people realize the vast scope of the automotive industry. Let us glance over the program of this Meeting and remember that each subject scheduled is a *general* subject, representative of an infinitude of detail. The materials of construction, research, design, construction and operation; motor vehicles, motor ships and aircraft; the internal-combustion engine, its fuel and all else that pertains to any one of them are touched upon either directly or indirectly as one follows this program through. Thus, the automotive industry is alive and enters into or influences every life.

Standards Committee Reports

The Reports submitted by 16 Divisions of the Standards Committee covered 35 subjects with reference to which recommendations had been formulated since the Summer Meeting of the Society at West Baden, Ind., last May. Thirty-two of the proposals were approved substantially as submitted, there being slight revision, resulting from discussion in the Standards Committee Meeting, of the recommendation for Non-Metallic Conduit and Copper Sheet, Specification No. 71. The Generator Flange Mountings report was referred back to the Electrical Equipment Division by the Standards Committee, and the revision of the Engine Testing Forms submitted was referred back to the Engine Division at the Society meeting.

Probably the most important report passed upon is that of the Iron and Steel Division, this being a complete revision of the entire Iron and Steel Specifications. The most extensive revision of the report was embodied in Part IX, General Heat-Treatments. This part gives an outline of the general heat-treatment for representative composition of the groups of S.A.E. Steels in accordance with the best modern metallurgical practice. It also includes revised data in the form of simplified charts of physical properties, extended to include a number of types of steel for which such data have not been published heretofore in the S.A.E. HANDBOOK. The Division is preparing similar data for the types of steel not so covered in its current report.

The report of the Passenger-Car Body Division also is important, particularly as it is the first report of this Division, which was organized as a result of the intense interest shown at the 1921 Annual Meeting of the Society with regard to body standardization.

A report was submitted by the Tire and Rim Division in the form of recommended practice for a revised list of pneumatic-tire and rim sizes for passenger cars and motor trucks. This recommendation was presented as a report of progress only, however, because of unexpected circumstances arising among the tire manufacturers in connection with such a recommendation. The Tire and Rim Division expects to submit a conclusive report on the subject at the 1922 Summer Meeting of the Society.

The Reports of the Divisions to the Standards Committee were published on pages 383 to 435 of the Decem-

ber 1921 issue of THE JOURNAL. The revisions in these reports, together with the important discussion of them, are specified elsewhere in this issue. A mail vote on final adoption of the reports as revised will be opened shortly and closed on March 11. All of the members who are entitled to vote will be furnished letter-ballots in this procedure under the Regulations Governing the Standards Committee.

AIRPLANE ENGINE SESSION

The first of the technical sessions, held on Tuesday evening, was devoted to airplane engines. There were 136 members and guests present and judging from the trend of the discussion they were about evenly divided as advocates of air and water-cooled engines. V. E. Clark guided the discussion as chairman, first introducing Charles L. Lawrance who read the paper of the evening on Air-Cooled Engine Development. Mr. Lawrance acquainted the audience with the intensive study that has been made of air-cooled cylinder design in this Country and in Great Britain during and since the war. He showed the progressive changes in the proportions and location of cooling-fins, styles of cylinder-head and provision for exhaust-valve cooling, and outlined those advantages of aluminum that practically demand its use for sections in which rapid heat-dissipation is essential. He stated that air-cooled engines developing approximately 25 hp. per cylinder, which are being produced commercially, have the same performance ability as the best water-cooled engines.

H. M. Crane opened the discussion with a summation of the weak points in connection with air-cooled engines that led him to favor water-cooled types. He expressed the view that the water-cooled type has proved to be more rugged, even when considered as a unit with the radiator and piping. He criticized the radial air-cooled engine as being difficult to overhaul and mount; and stated that the fins break too easily, that the visibility of the pilot in a forward direction is reduced unduly with this type of engine, and that he had found the task of conducting the exhaust gases away from the pilot difficult. D. R. Harper mentioned a Bureau of Standards test that indicates that 16 per cent of the head-resistance due to the engine is caused by engine parts and valve-gear that play no part in the actual cooling. He agreed with Mr. Crane that the centering of the cooling function in the radiator makes it possible to combine minimum head-resistance with maximum cooling-efficiency. G. J. Mead, in his prepared discussion, compared the reliability, performance, durability and cost of air and water-cooled aircraft engines. He advanced the opinion that the two types are equally reliable; that the advantage in performance of either type has not been established in flight tests; that the water-cooled engine is the more durable; and that there should be little difference in first cost. Further, that the air-cooled aircraft engine still has to prove its power, durability and controllability in extensive service-tests. Capt. G. E. A. Hallett, of the Air Service Engineering Division, felt that the greatest percentage of forced landings has resulted from failure somewhere in the water system of water-cooled engines. For this reason alone, he recommended that air-cooled airplane-engine development be encouraged. He mentioned the attainment of 130 lb. per sq. in. brake mean effective pressure in an experimental air-cooled cylinder at McCook Field, with very low fuel-consumption. This compares favorably with water-cooled engine performance. In these tests the exhaust-valves cooled very satisfactorily, Captain Hallett stating that in this respect the engine was superior to the Liberty engine. H. S. McDewell contributed discussion on the matter of comparative steps in heat transfer as between water and air-cooled cylinders. He also called attention to the fact that nose-type radiators are being superseded by radiators of increased efficiency and lessened head-resistance that are mounted elsewhere in the slipstream. This development naturally enhanced the water-cooled engine's all-around desirability. Mr. McDewell presented last-minute data on the performance of an air-cooled engine of Mr. Lawrance's design that was tested by the Navy, this engine producing a brake mean effective pressure of 123.3 lb. per sq. in. S. D. Heron, a former associate of Dr. A. H. Gibson, of England, answered many of the questions raised in the discussion and his remarks were received with unusual interest in view of his intimate relation to most of the British air-cooled engine research during the war. C. B. Dicksee submitted some cylinder-temperature data and emphasized the importance of Mr. Lawrance's paper to the automobile engineer who is seeking a means of accomplishing the proper combustion of heavy-end fuels.

In closing the discussion, Mr. Lawrance disagreed with Mr. Crane regarding the matter of the air-cooled engine's ruggedness and called attention to the simplicity of its crankshaft and bearings. He said that the same care must be exercised in handling water-cooled engines as in the case of air-cooled engines; and that more serious damage would result from water-pump or jacket breakage than from broken cooling-fins. The simplicity of procedure in the mounting and dismounting of the air-cooled radial aircraft-engine was cited by Mr. Lawrance as a strong point in its favor, and he was of the opinion that the major working parts of the engine are more accessible than those of the V-type water-cooled engine.

BUSINESS SESSION

The new plan of conducting the business session met with much favor, the reports of the Vice-presidents of the Society, in addition to the address of the President, holding a great deal of interest and value to the members. The intention to portray the respective automotive activities of the Society during 1921 was well carried out.

RESEARCH

H. M. Crane, vice-president for aviation, and chairman of the Research Committee, discussed briefly the work of the Research Department, Dr. H. C. Dickinson being forced to be absent owing to illness in his family. Mr. Crane said that one of the most important things regarding research work is the collection and dissemination of information. Whether consciously or unconsciously, in the past many have come to the meetings of the Society hoping to meet other engineers and talk over this, that or the other problem with them. That, undoubtedly, is the most pleasant and profitable thing to do, but it is not always possible, and for many of the younger members it is practically impossible. The Research Department, if it meets expectations, will help to fill this gap and act as a great clearing-house of information for all the Society members, including the juniors and everyone who is interested in research work.

The second idea is that this collection and dissemination of information will initiate a great educational movement throughout the ranks of the Society and also in many institutions such as universities and laboratories where research work is undertaken. A great quantity of research work fails to produce worthwhile results on account of wrong methods of attack or the use of insuffi-

ciently accurate apparatus. Sometimes an entire misapprehension of the problem that is being attacked is followed by a number of very interesting readings that have no bearing on the subject.

Undoubtedly in the long run the university laboratories will be very useful adjuncts to the already over-worked laboratories of the industry in connection with the many problems of research that are confronting us.

Mr. Crane asked for the earnest cooperation of all the members of the Society in answering the Research Department questionnaires, furnishing all the information that they reasonably can, with due consideration for the rights of their own companies. He said that if they do this they will get in return from the Research Department information of value in greater amount than they furnish it to the Department.

PROGRESS IN AVIATION

Mr. Crane expressed the conviction that aviation made a great stride forward in 1921 in spite of the relatively small amount of money available for development work. The steady efforts exerted in many countries to make the airplane commercially useful have added greatly to our fund of knowledge and have been laying a foundation on which eventually will be built a most important addition to our means of transportation.

The attempt to use wartime machines in commercial service resulted in many failures so far as economic effectiveness is concerned, but from each failure came some additional data. The men of the industry and, to some extent, the public are becoming acquainted with what service can reasonably be expected. During this year a still greater advance in the direction of realizing just what real transportation service is should be made. A lack of this realization in the past has been the cause of our failure to make the most of the wonderful speed of the airplane.

In many cases those attempting to establish airplane lines have not seemed to appreciate that in the case of passengers the points of departure and of destination are almost invariably the home and the office, and in the case of mails or merchandise the post-office and the warehouse. The time in transit will be figured invariably in this way and no amount of speed during portions of the trip will have any permanent effect on the public point of view. The greatest handicap that must be overcome before we can expect to see commercial aviation successful on any considerable scale is the almost entire absence of terminal facilities adapted to commercial service. As it is usually stated, we have no suitable landing-fields. For commercial purposes the location of landing-fields is of essential importance. The Pennsylvania Railroad spent many millions of dollars to bring its passengers across the Hudson River and into the heart of New York City, and yet before the building of the Hudson River tunnels the Pennsylvania station and its various Metropolitan terminals were far better located for commercial transportation than the most accessible landing-field near any big city. The fact that an airplane can fly 100 m.p.h. means nothing at all if the terminal facilities do not allow a satisfactory use of that speed. Until we encourage the people of the Country to provide terminal facilities that are useful for commercial transportation, we will not have any commercial transportation. Each one of us can, by using his influence and talking to others, including political representatives, assist in fostering a point of view that will bring a big improvement in this line. The commercial airplane-terminal will have to be for a long time to come a community interest of some kind and, presumably, financed and controlled by the Government.

It is natural that the present situation exists. Most of the flying fields were started as experimental flying fields and were located at considerable distances from centers of population. We have not begun to make an impression on what should be done where the greatest amount of commercial transportation is going to be required in the long run; that is, between cities like New York, Chicago, St. Louis, Boston and Philadelphia. It is only under the most favorable circumstances in length of haul and poor railroad service that the airplane can be expected to overcome the present inefficiency in terminal service. It is clearly the duty of the Society to preach the gospel of air transportation and to point out the only road that can lead to ultimate success.

This short review would not be complete without a reference to the bombing tests carried out jointly by the Army and the Navy last summer. These tests showed a degree of efficiency in the percentage of hits and in the destruction caused by the larger bombs that created a very considerable sensation among the people as a whole. I do not agree with those that see as a result of these tests an immediate revolution in methods and apparatus of warfare on land and sea, but there is no question that the aviation arm will hold in the future an even more important place in the scheme of national defense.

The past year has seen many new records made in aviation, of speed, altitude and endurance, but I think that the most important records have been made in the Air Mail Service and in the transportation lines, both here and abroad. Records of the sporting type have their uses in stimulating the imagination and in arousing general public interest. They also furnish considerable engineering information of value, but the thing that we need now is the knowledge of how to conduct a regular daily service at a minimum cost and fairly certain data as to what that cost will be.

There has been a considerable advance during the past year in the construction of both powerplants and planes. It has been proved that the powerplant and plane must be the result of painstaking development and gradual evolution. They cannot be produced by a sudden leap into the dark on the part of the designer. This is particularly the case in respect to the complete airplane in which the installation of the powerplant and accessories has the greatest possible bearing on the safety of the operation. I have never been able to see how a really good installation could be expected on the first model of a new design, when the designer's attention is naturally focused on the strength of the airplane fabric and its flying characteristics. It is only on the second or third model of a given series that the installation gets the attention that it deserves. The same thing applies to the engine designer, who now has time to realize that the engine must be mounted in an airplane to be of real service, and that a successful brake-test is not the final answer.

TRACTOR ENGINEERING

Concerning the tractor engineering developments of 1921, Vice-President E. A. Johnston reported that, while much of the previous development activity was curtailed, due to retrenchment, considerable valuable work had been done through concentration on essential problems. There is an evident desire on the part of both the builder and the owner of tractor outfits to favor a dependable, as well as more durable, outfit, making these two factors take precedence over a minutely economical unit as re-

gards fuel. This is particularly noticeable in the choice of second purchases, repeat orders being almost uniformly in favor of the higher-grade equipment.

High-class construction now includes working parts of high-grade material, parts fully enclosed from dust and dirt, well lubricated bearings, liberal use of high-grade anti-friction bearings or, in the case of plain bearings, liberal proportions of good quality. Heat-treatment of steels has been extended to all parts adaptable to this process and its refinements.

Reducing the weight of tractors by the use of high-grade materials and designs has necessitated more and more attention being given to wheels and lugs. Therefore much work has been done during the past year to establish the relative values of various types of lugs, widths and diameters of wheels, and the relations of speed to draft, although there is still a great amount of research work to be done along these lines. The generally accepted operating and plowing speed is now approximately 3 m.p.h.

While many two-plow outfits have been produced, and their sale has excelled, there is a tendency toward a larger or three-plow tractor that will accomplish 50 to 60 per cent more work at the same labor cost. Further, there is a marked tendency toward operating the wheels of a wheel tractor in the furrow, which limits the width of drive-wheels to 12 in. for a 14-in. bottom. This, together with the tendency toward reduced weight, results in more difficult problems of developing lug equipment, lubrication, and meeting the various conditions due to slippage and steering.

Elements and equipment such as ignition apparatus, carburetion and distribution, lubricants and methods of lubrication and air-cleaning have improved noticeably. These features are relatively more necessary to the purchaser than refined economy. The convenience and safety of the operator have been studied better, resulting in greater comfort and less strain during operation.

A distinct interest has developed and brought forth much improvement in power equipment, to be used with and without the tractor, thus extending the usefulness of power-driven apparatus.

Standardization work has received much attention, especially along the lines of bolts, nuts, valves, splines, bearings, ratings, material, belt speeds and pulleys.

Some interesting development in light-weight tractors of the track-layer type has appeared. Also, considerable progress has been made in the development of steam powerplants for tractor purposes.

The ever-present question of liquid fuel, its cost, supply and suitability, has caused a marked demand for alcohol developments. This call comes largely from foreign fields, where sugar refuse is available, as in the Philippines, Hawaii, Cuba, Brazil, Argentine, Esthonia and France.

The agricultural farm power equipment industry is firmly established and with the continued improvements and refinements, resulting in greater dependability, durability and economy, it is reasonable to assume that the demand for this class of equipment will increase rapidly.

THE MOTORBOAT FIELD

Vice-President Joseph VanBlerck said that when the Society inaugurated the development of standardization in the motorboat field, enthusiasm was high and interest very keen. Many promising projects were undertaken and some of them were well started when the war interfered and it became almost impossible to get members together on this work. After the war, by the time the work could be taken in hand again the present depression in business had set in, and since the engine and motorboat industries received their setbacks along with others, the matter has been practically at a standstill.

The most pressing need is to secure the cooperation of additional members in the work of the Motorboat Division of the Standards Committee. The standards that have been formulated by the Society, applying to motor vehicles, have been almost universally adopted. This alone proves the value and need of standardization work. In fact, the use of the S.A.E. Standards in the motor-vehicle field is becoming so much a matter of course that there is danger of the credit for the establishment of them by the Society being overlooked by manufacturers in general.

STATIONARY INTERNAL-COMBUSTION ENGINEERS

Theodore C. Menges, second vice-president for stationary internal-combustion engineering, submitted an excellent analysis of the business and engineering conditions in this field. He said that the great volume of the business comes from the demand of the farmer and that there is a gradual slacking up of the industrial tension and that sales are beginning to pick up.

The stationary-engine business has been built up by various companies specializing on certain types of engines. Very few have tried to cover the entire field. The business naturally groups itself under the following divisions:

(1) Large engines
(2) Electric-Light Engines
(3) Pumping Engines
(4) Concrete-Mixer Engines
(5) Milking-Machine Engines
(6) Railroad-Section Handcar Engines
(7) Contractors' Engines
(8) Air-Compressor Engines
(9) Well-Drilling Engines
(10) Farm Engines

By large engines are meant engines of 15 hp. and over. They are used principally for operating (*a*) powerplants, (*b*) custom elevators, (*c*) custom feed mills, (*d*) waterworks, (*e*) electric lights, (*f*) grain threshers and (*g*) ensilage cutters. For purposes *a*, *b*, *c*, *d* and *e* the engines are usually of the single-cylinder horizontal type. Some of the larger plants are equipped with vertical multiple-cylinder engines. For purposes *f* and *g* single-cylinder horizontal portable engines are used mostly. The tractor is gradually crowding out this type of engine for grain threshing and ensilage cutting.

There are two types of electric-light engine; the large stationary engine for small cities and the small self-contained unit for individual use. The large engines usually have extra-heavy flywheels and run at a higher speed than ordinary stationary engines run. They are generally throttle-governed, and run on kerosene. The small self-contained electric-light unit is a vertical engine direct-connected to a dynamo. The entire apparatus, including the switchboard, is mounted on an iron subbase. The tendency is to furnish a radiator and a fan for cooling the water. Some of the very successful plants are air-cooled. Nearly all of them operate on the four-cycle principle.

For small pumping jobs most of the engines used are of the ordinary single-cylinder horizontal type. The pump is operated by a belt-driven jack that is clamped

directly to the pump. Another type of engine is geared to the pump. In this the jack is built into the engine. For heavy deep well-pumping, the type used is called a geared-base engine. It has a set of larger gears and bearings built into it. This type is used at waterworks and railroad-pumping stations.

Both the vertical and the horizontal types of engine are used for concrete mixing. Working in the dust and dirt, it is necessary to have them well housed. This line of business is about the most active of any at the present time. This is, no doubt, due to the price of concrete compared with wood construction and to the greater use of concrete for building purposes.

Milking-machines have provided a new field for stationary engines. The engine usually is equipped with a reduction-gear to give the slow speed required by the machine. The engine is used to operate the vacuum pump that forms the principal part of the machine. This field is growing very rapidly. The milking-machine is proving to be of great assistance to the dairy farmer.

The smaller type of engine is used on the common handcar. The pump levers are taken off, a pulley is put on the axle and a belt from the engine drives the handcar. In some of the larger and more elaborate jobs the installation consists of a multiple-cylinder engine with a transmission. The use of an engine saves a great amount of time and has proved to be of great value, not only to the section-man but to the railroad itself.

Stationary engines are used by contractors to fill ditches and to operate cut-off saws, planers, and similar machinery; also for hoisting purposes, in which case a geared-base hoist is built into the unit.

For garage use air-compressor engines are usually small and of the horizontal type, driving the compressor with a belt. For larger jobs the engine is direct-connected to the compressor and both are mounted on a substantial iron subbase.

Well-drilling engines are usually of the horizontal type and mounted on the same truck as the well drill. They have an attachment on the governor, so that the engine speed can be varied. A large number of these units are self-propelling. A recent oil-well drilling outfit included a large four-cylinder vertical engine. This job was 50 ft. long between the wheels and 25 ft. high. It weighed 10 tons.

Engines used on the farm are of various sizes and for different purposes. The small horizontal engine is used mostly for pumping. It runs also the washing-machine, the cream-separator, the churn and the milking-machine. The larger engines are used for sawing wood, grinding feed or cutting ensilage. The demand is for an engine that is complete, with all parts mounted on skids, so that it can be moved around.

Ignition

Electric ignition of the battery and the magneto types is used. The source of electricity for the battery ignition has settled down to the dry battery. The most common form of battery ignition is the make-and-break. Due to the fact that the batteries do not last long and are not reliable enough, this form of ignition is gradually being displaced by magneto ignition.

Three methods of low-tension magneto ignition are in use: (*a*) high-speed rotary, (*b*) direct-geared rotary and (*c*) oscillating. The high-speed rotary magnetos have been driven from the rim of the flywheel, delivering a direct current passing through a coil. This form is rapidly disappearing due to its mechanical shortcomings. Direct-geared rotary magnetos are used on almost all makes of stationary engine. They are simple in construction and, running at engine speed, are very durable and reliable. Oscillating magnetos are of the high-tension and the low-tension types. The high-tension oscillating magneto has not been used to a very great extent in this Country, but is used largely in foreign countries. The low-tension oscillating magneto is being used on some makes of engine. It is installed in connection with a make-and-break igniter and forms a part thereof. The mechanical action of the heavy springs that jerk the armature of the magneto at the time of producing the spark is a serious drawback to their use. They are good for starting an engine, but are subject to severe strain when the engine gets up to speed.

Governors

Centrifugal governors are used on stationary engines. They are operated generally at crankshaft speed but are sometimes geared to run at higher speeds. They operate on two different principles. Governors that control the butterfly or throttle-valve located in the intake-manifold control the speed of the engine. The engine takes an explosion every time, but the strength of this explosion is controlled by having a heavier or lighter charge of the mixture taken in to the cylinder. This form is usually called throttle-governed. The hit-and-miss governed engines, which are in a large majority at present, control the number of explosions or charges that are taken into the cylinder. This is accomplished by causing a catch to stop the valve motion, and to hold the exhaust-valve open. A heavy load will cause the engine to take a large number of explosions. A light load will cause it to take a small number of explosions. In this form of governing the quality of the charge and the compression-ratio always remain the same. Consequently, these engines are very economical. The exhaust-valve, being held open, allows the engine to draw in and expel several charges of cold air. This keeps the engine cool and helps to scavenge the cylinder. Hopper-cooled engines use less water when of the hit-and-miss type than when throttle-governed, because they have a chance to cool down between explosions. It is for this reason that this type is seldom run on kerosene. Kerosene is generally used in throttle-governed engines because they stay hotter.

Cooling Systems

Air-cooling is used on some of the smaller engines. It is used extensively in cold climates where there is danger from freezing the cooling water. It has not proved practical for the larger heavy-duty engines. Water-cooling is accomplished in several different ways. Tank cooling consists of having a large stationary tank filled with water and allowing the water to become cooled by evaporation and by contact with the air. Overflow water running through the cylinder jacket and discharged after being used is the method most employed on very large engines. This is wasteful of water, but gives the best results, as the temperature of the cylinder can be accurately maintained at the most efficient point. Radiators, installed with a fan, are suitable for complete unit powerplants. They take up a very small space and do not require much water. They are employed on a large number of small electric-light plants. They are fitted also to portable engines. Water-pots or hoppers are in use on almost all small stationary engines. The water-pot is simply an enlargement of the top half of the water-jacket. It holds enough water to keep the engine cool

for ordinary work. It is easy to fill and drain, is durable and has proved its worth.

Lubrication

The lubrication of the engine is, of course, very important. There are four principal methods in vogue at the present time: (*a*) drop-feed, (*b*) mechanical, (*c*) splash and (*d*) grease-cup. Drop-feed oilers are used on almost all small engines. They have a pipe inside of them to equalize the pressure above and below the oil. A ball-check prevents the explosion pressure from blowing into the oil. A screw-stem pointed at its lower end regulates the flow of the oil. Mechanical oilers are common on the larger engines and on portables. They are driven by a belt, a chain or gearing. They are positive in their action and are considered valuable. Splash lubrication is found principally in vertical engines with enclosed crankcases. Some horizontal engines have this system, although it is not very reliable or much used in this type because too much oil is thrown into the cylinder. Grease-cups are fitted on almost all small engines. They lubricate the connecting-rod and main bearings. Grease seems to give better results on babbitt bearings than oil. These cups require very little attention and are very reliable. A cup usually has to be filled only once a day.

Gasoline Mixers

Gasoline mixers as used on stationary engines are operated according to three different systems: (*a*) float-feed, (*b*) pump-feed, and (*c*) suction-feed. Float-feed mixers are employed on unit electric-light plants and on some portable engines, although not very extensively. Pump-feed mixers are used on a number of engines. They are made in two styles: (*a*) force-pump and (*b*) submerged-pump. The force pump draws the gasoline from a tank located outside of the building, or out of the engine base, and forces it into a small reservoir attached to the mixer. The surplus gasoline flows back to the tank. This system is found principally on large engines and is recommended by the insurance companies. The submerged pump has its plunger submerged in the gasoline contained in the reservoir. It simply lifts the gasoline from the tank and discharges it into the reservoir that forms a part of the mixer. Suction-feed mixers are components on almost all small engines. The suction of the piston in the engine draws up the gasoline directly from the tank into the cylinder. A check-valve keeps the gasoline from flowing back and prevents back-firing in the tank.

New Designs

A few new engines have been put on the market this year. Among these may be mentioned the Cushman, the Stover, the Waterloo Boy and the International. These new-style engines are smaller and lighter than previous models, run at a higher rate of speed, and are well balanced and govern very satisfactorily. There is a tendency to use steel drop-forgings as much as possible. Die-cast removable bearings are employed almost exclusively. These are made of babbitt only and are not bronze-backed. There is a tendency toward lead-base bearings, which seem to run cooler. These engines are all hopper-cooled. Most of them have their base, frame and cylinder cast in one piece. Several of them have a removable sleeve inside the cylinder to permit replacement after wear or breakage. Accurately made interchangeable parts are used to a great extent. Smoother and better finished castings on these engines indicate an advance in foundry practice.

Where possible the S.A.E. Standards are being incorporated in their design. This is especially true in the case of piston-rings.

During the war practically all stationary engines were put out to run on kerosene, due to the high cost of gasoline. This forced the builders to use throttle-governed engines. They gave good satisfaction on fair loads, but on light loads, as when pumping water, they were not entirely satisfactory.

The hit-and-miss engine is back in the field again and seems to be the one mostly demanded.

Conclusion

Summing up the status of the stationary engine today, Mr. Menges said that the demand is for a comparatively light-weight, high-speed, hit-and-miss engine. The engine has a tank in the base and suction feed. It has a make-and-break igniter and a low-tension built-in magneto. It is hopper-cooled with water. It is entirely self-contained and is mounted on a set of substantial skids. It has smooth well-finished castings and is painted to withstand outdoor usage.

The prospects for the future trade are good and a steadily increasing demand is expected. As in all other lines, it will be a matter of the survival of the fittest. The manufacturer who meets the demand honestly and fairly will certainly reap the harvest.

THE STATUS OF THE ENGINEER

President Beecroft addressed the members on The Status of the Engineer in Automotive Economics, after paying his "very highest and sincerest respects to the excellent Council and the organization that stood back of the Council" during his administration. He spoke of this period as 12 months of wonderful cooperation, the members of the Council, the Officers, the chairmen of the committees and the office staff showing that devotion to work by much sacrifice of time and energy that alone makes a society such as the Society of Automotive Engineers possible.

He said

> I direct your attention to the future because I believe that today we must look to the future; we must accept the old adage, Let the dead past bury its dead. We must act in the living present and make our actions of today efficient by having our vision focused ahead on what we believe to be the eventual goal.
>
> I would be, in trying to add to the picture that has been made before you today, as a schoolboy in his earliest hours of school, with shaking hand, with untrained muscles, with untutored mind, attempting to create what will be his and what he will execute in the years to come. We should survey the past to see how easy has been our course. The roots of the present are always found in the past, and we must study the past if we are to proceed correctly, interpreting sanely the days that are to come.
>
> In the last 20 years our paths have been rather pleasant. I wonder whether we appreciate how fortunate we were in the days when we laid the foundations of our industry. We have seen the national wealth of our Country more than doubled since 1900. Has not our national per capita wealth had very much to do with the wondrous, spectacular and unprecedented development of the automotive industry?
>
> Let us, as we stand in the midst of the greatest problems that have confronted our industry, be sure that we have the correct perspective, and be not blinded by the successes of the past, which have come not entirely because of efforts that we have exerted but largely on account of the rapid development of industry during the first 20 years of this century.

Let us look briefly at agriculture and see the development that has been made in it. Bear in mind that 45 per cent of the population of this Country is dependent for livelihood upon agriculture. We have learned during the last year that when agriculture is depressed the cities in the agricultural areas follow its course closely. The towns of 2000 population respond almost instantly to the condition of the individual farmer. The cities of 40,000, 60,000 and 100,000 population in the agricultural areas of the great Mississippi Valley reflect the economic status of the farmer within not over 8 to 10 months.

To be specific, take a city in Iowa that had an unexpectedly good business during part of 1921, while the farmers of that State and the farmers of the corn belt were not purchasing. It stopped purchasing some 3 or 4 months ago, and the reason is not far to seek; the farmer had not paid his bills to the merchants of the city; he had not met his obligations at the banks, which were naturally shorter of fluid funds than they were a year ago. We cannot divorce the towns and cities of an agricultural area from its farmers.

The value of farm property has doubled while we have been working to build up our industry. The total value of farm machinery per farm has increased three-fold since 1900. This machinery has increased production; it is partly the cause of the movement of the boys from the farm to the centers of population.

We have had also an increasing crop-value. Corn, our greatest crop, had a value of $9 per acre at the opening of this century. Today its average value per acre has risen to $15. Perhaps we find in that one of the reasons we have had the great sale of automobiles to the farmer. If we take our spring wheat crop, we find again that its value has increased from $7.50 to over $12 per acre. The oat crop has increased from $7 to approximately $11; the potato crop from $34 to $62. Our great cotton crop has increased in value per acre from $15 to $23. In the case of the winter wheat crop we find an increase of from $8 to $13 approximately. Bear in mind that these are not war increases but the equivalents of increases up to the year 1913.

Have we not as an industry profited greatly from these increases in farm and crop values? Are we giving those agricultural conditions that we have come through due credit? If we considered the increases during the period of the war, we would see in each case a greatly ascending curve which, of course, has fallen off in the last year.

Let us, as representatives of our industry, give credit where credit is due. With the figures I have quoted in mind, we can perhaps discount better the problem that lies ahead. It is generally conceded that we will not see in the next 20 years another great increase in crop values, because other agricultural areas of the world, such as Argentina, Australia, India, Egypt and the Union of South Africa, as well as Western Canada, are coming into very close competition with us.

INTERNATIONAL AFFILIATION OF ENGINEERS

First Vice-President Horning spoke on the subject of international affiliation of engineers. He said:

Strikes are going on all the time that have nothing to do with labor; there are strikes of capital and there are strikes of men who are quietly desisting from doing the things that, in view of their peculiar mental and temperamental characteristics, they should be doing for the world. Capital is on a great strike. It is buying up tax-exempt bonds. This is one of the grievous economic and financial problems of the Country.

Laborers are going on strikes, or have gone on strikes in the past, but there is a strike that is eating insidiously at the great benefits the world should have from engineers and inventors, and that strike is the one thing that is keeping us from solving many problems. I maintain that throughout the world there are ideas in the safe boxes and in the minds of men that would solve many a problem if these men were sure of a fair deal or a just return for their effort. One of the things that have prevented many very good inventions in this Country, as well as in Europe, is that inventors invariably have felt that they were not sure of a return. Only in the dire stress of poverty have they let go of some of their ideas. Our fuel problem and many of the most serious problems that face us are suffering for solution because inventors are not sure that they will get their just return in the markets of the world.

If our patent system could be revised so that there would be fairness to inventors, if it were more certain that their efforts would be rewarded and that there would be sure jobs for them, and that they would be comfortable in their work and happy in their environment, great things would come.

I have received so much benefit in my own work from contact with foreign engineers that I cannot help but pay a great tribute to them. Before the war the isolation of Europe was almost complete to all except the chosen few. Today it seems no farther off than Boston or Cuba seemed then.

Engineers have been drawn together and the co-operation between the engineers of the struggling nations that led to magnificent accomplishments during the war has emphasized the great value that accrues to those who are willing to accept the influence of the broader aspects. There exists a fundamental difference in viewpoint that arises out of the character of the trade that must be served by the engineers of different countries and out of the difference in their academic training and national temperament. But from a closer contact of engineers throughout the world there will develop a higher and better type of engineering.

Not over-estimating the advantages of typical American engineering, which reaches its highest stage in designs suitable for quantity production, American engineers are interested intensely in the tendencies of foreign design in connection with solving the serious problem of economical operation. The foreign markets are limited compared with our own. At this time one-third of our States have each more cars than there were in Germany, France or the British Isles at the beginning of the war. This limitation of market, the distribution of national wealth, the cost of fuel, good roads, short distances and congested traffic have combined to present problems that have been solved by the foreign engineers but are just commencing to present a serious aspect to our engineers.

The great profession of engineering is thoroughly conscious of the fact that world-wide problems face the engineers of every country and that there is a wide-open door with respect to them. There is no such thing now as isolation. With Russia, Germany and Austria in economic, financial and political collapse, we find our own Country in distress. Every part of the world is so sympathetic to conditions in its other parts that nothing can happen in any activity that is not felt instantaneously throughout the world. Having nearly 40 per cent of the gold of the world in our possession, and blessed with practically unlimited national wealth, we suffer business depression and financial distress because of the disturbed and depleted condition of Europe. Engineers in general must become more and more familiar with what their brethren throughout the world are thinking, experiencing and accomplishing.

Our industrial capacity developed by the war makes world markets necessary to our prosperity and economic stability. Engineers must be not only good scientists but also thoroughly practical world-economists. Whereas isolation has been apparently of great advantage to the mechanical trades, as evidenced by the inhospitality accorded visitors at plants, discriminating

tariffs, sparse interchange of technical literature and other forms of provincial aloofness, there is now a pressing demand in every human activity for a relaxation of regulation and a breaking-down of artificial barriers to international intercourse. Contact, association, intimate concourse, and free unobstructed international exchange will tend to keep the world at peace. An International Affiliation of Engineers has a great place in this new world of ours. Kept free from political tendencies, it will rise high in service to mankind and in promoting the pursuits of peace and happiness.

There are pressing problems of standardization, such as an International Screw-Thread Standard, the solution of which we may have to leave to future generations. We have built up immense debts for our children and grandchildren to pay. We shall fail in our larger opportunities as engineers if we do not aid them by arriving at standards that will make a ship at home in any port when it comes to repairs, and permit connecting to a port water-hydrant with an interchangeable screw-coupling in distant lands. All the various mechanisms of the world should be repairable with standard bolts, screws and nuts, alike in India and in Indiana.

Science is the foundation of engineering. Science is bringing the mind of man closer and closer to the sublime truth as to the unity of all things. Some of our most practical problems hang on the intimate knowledge of the constitution of matter. Our fuel problem rests on the same laws that make it possible for radium to melt ice in an amount equal to its own weight every hour. No nation has a monopoly of minds that will solve ultimately the enigma of matter and of energy, which when known will solve the problems of science, engineering, commerce and life.

The methods of research that arise out of national mental characteristics are of great assistance, but the assimilation of the results made possible by them is always deterred by the lack of standards of procedure and measurement. Here a great matter presents itself for solution.

Engineers must be first good scientists, then good psychologists, then good economists. It has been said that a failing of engineers is that their minds have been limited by the bare necessities of their profession. This, if true, must be obviated. Engineers can meet in full measure their duties and opportunities only when their interests and contacts are world-wide.

The Society of Automotive Engineers has been fortunate in its contact with world engineering, through its thoroughly patriotic cooperation with the Government, before and during the war, its visits abroad, and its hospitality to societies of foreign lands. It has been fortunate in having presented to it technical papers by such world authorities as Sir Dugald Clerk, Harry Ricardo, Dr. Harold Dixon, and others.

The Society looks forward with hope to a broader and more sympathetic cooperation of the engineers of the world and contemplates trustfully an effective International Affiliation of Engineers. Ambassadors of the arts and sciences can go further in the direction of world peace than "diplomatic covenants openly arrived at."

TABLE 2—APPLICATIONS FOR MEMBERSHIP RECEIVED

Date	Factory Representative Campaign[1]	Other Sources	Total
1920			
April	84	61	145
May	107	65	172
June	74	38	112
July	38	37	75
August	10	93	103
September	11	90	101
October	1	86	87
November	1	88	89
December	2	56	58
	328	614	942
1921			
January	3	68	71
February	0	65	65
March	3	89	92
April	19	77	96
May	31	59	90
June	12	54	66
July	5	19	24
August	3	32	35
September	1	36	37
October	2	47	49
November	3	63	66
December	2	72	74
	84	681	765

[1]The Factory Representative Work was begun in April, 1920, and in March, 1921.

MEMBERSHIP INCREASE

W. A. Brush stated that 2 years' experience as Chairman of the Membership Committee had led him to feel that there is not much to be said about membership increase work, but considerable to be done. He continued: I wish to say, very briefly, that in 1920 we started a membership campaign about which you all know something. I refer to the factory representative plan. That worked nicely during 1920, and we thought it would continue to function during 1921; but it did not. Our membership increase fell off during 1921 because we did not

TABLE 3—INCREASE OF MEMBERSHIP

End of Year	Total Members	Percentage Increase
1909	393	...
1910	654	66.4
1911	982	50.1
1912	1.447	47.3
1913	1,713	18.4
1914	1,743	1.8
1915	1,783	2.3
1916	2,121	19.0
1917	3,284	54.8
1918	3,986	21.4
1919	4,516	13.3
1920	5,231	15.8
1921	5,317	1.6

TABLE 1—COMPARISON OF SOCIETY MEMBERSHIP BY GRADES

Grade	Dec. 31, 1919	Per Cent of Total	Dec. 31, 1920	Per Cent of Total	Dec. 31, 1921	Per Cent of Total
Service Members	13	0.3	18	0.3	65	1.2
Foreign Members	11	0.2	50	1.0	67	1.3
Members	2,360	52.3	2,706	51.7	2,723	51.2
Associates	1,350	29.9	1,495	28.6	1,509	28.4
Juniors	514	11.4	692	13.2	671	12.6
Affiliate Members	95	2.1	112	2.1	107	2.0
Affiliate Member Representatives	110	2.4	117	2.2	85	1.6
Enrolled Students	63	1.4	41	0.8	90	1.7
Total	4,516	100.0	5,231	100.0	5,317	100.0

work hard enough in membership work. Within the last 90 days we have started a new type of campaign and are already getting some results from it.

A very significant and, to my mind, pertinent fact has made itself evident during this year. We have been securing membership applications from a constantly increasing number of industrial executives, general managers, production heads, and presidents of companies. I think that that indicates a perception, and I am using that word advisedly, on the part of the executives of the work that this Society has done for the industry and for them, for the executives, not for the engineers; and they are gradually indicating that perception by coming into the Society.

That brings me to what our beloved First Vice-President said a little while ago about engineers. Perhaps at some time in the future invention, the child of the engineer's brain, will be represented and considered as property just as much as the capital dollar is considered as property. Then we will have an engineering society that will function for the benefit of the engineer at least as much as it does for the benefit of the industry at large and for the capitalist.

That, I am convinced, is what this Society has done since its inception and is doing. It has benefited the industry and the executive as much as if not more than the engineer. So, if some time in the future there may be an engineering society that has the interest of the engineer at heart, we will have no trouble with the membership as far as the engineers are concerned.

MEETINGS COMMITTEE

Chairman C. F. Scott, of the Meetings Committee, in submitting its report, said that it has been the policy of the committee to make as small a draft as possible on the general income of the Society for meetings attended by a certain proportion of the members, so that as much as may be of the Society's income shall be available for those services that all members receive. He presented the following statistics:

Society Meetings Held during 1921		5
Annual Meeting, New York City, Jan. 11-13		
Chicago Meeting, Chicago, Feb. 2		
Tractor Meeting, Columbus, Feb. 10		
Aeronautic Meeting, Dayton, May 21		
Summer Meeting, West Baden, May 24-28		
Sections Meetings Held under the Auspices of Sections Committee		46
Papers Presented at Society Meetings and Published in THE JOURNAL		59
Papers Presented at Sections Meetings and Published or Considered for Publication		42

	1921	1920
Attendance at Annual Meeting	804	1,196
Attendance at Annual Dinner	1,107	1,504
Attendance at Carnival	815	770
Attendance at Summer Meeting	698	887

Allotment to Meetings Committee in Society Budget for Direct Expenses $15,500.00 (74 per cent of Budget)
Amount Actually Expended
$10,379.17 (67 per cent of Allotment)

	1921	1920
Cost per Member for Meetings, Direct Expense after Deducting Income	$1.92	$3.24
Average Membership on Which Cost per Member Is Based	5,400	4,673
Cost per Member for Allotment General Expense, Meetings Department	$4.90	$6.67
Total Expense per Member for All Activities of the Society	$43.00	——

The Society has followed for years the policy of making its Summer Meetings self-sustaining, except for general staff expenses, by a direct charge on the members. Other meetings are made partly self-sustaining by a charge for dinner tickets.

Last year for the first time a slight additional charge for guests over that for members at the Summer Meeting was made as a matter of fairness to those who pay annual dues. A similar differential was made for the attendance of guests at the Dinner and Carnival of the 1922 Annual Meeting.

The presentation of papers at the Society and the Section Meetings is recognized today as a privilege and a distinction worthy of the best thought and effort of the leading engineers residing in this Country and abroad.

THE SECTIONS

The report of the Sections Committee, submitted by H. R. Corse, its chairman, is printed in full elsewhere in this issue of THE JOURNAL. Mr. Corse said that the Sections Committee's work has consisted of taking up the problems that came to it from time to time throughout the year, due largely to the difference of conditions in the places where the Sections of the Society are located. The Committee investigated the conditions as thoroughly as possible and then made recommendations in connection with them to the Council of the Society.

ELECTION OF OFFICERS

H. W. Slauson, H. G. McComb and A. M. Wolf were appointed tellers of election of officers to serve during this administrative year and of councilors to serve during 1922 and 1923.

They reported that 774 ballots had been cast, 45 of these being void. The total count on election was as follows:

President

B. B. Bachman	735
Scattering	2

First Vice-President

J. V. Whitbeck	736

Second Vice-President
Representing Motor-Car Engineering

F. E. Watts	734
Scattering	1

Second Vice-President
Representing Tractor Engineering

O. W. Young	734

Second Vice-President
Representing Aeronautic Engineering

V. E. Clark	731

Second Vice-President
Representing Marine Engineering

H. E. Morton	732

Second Vice-President
Representing Stationary Internal-Combustion Engineering

C. B. Segner	734

For Members of the Council
(To serve for 2 years)

H. M. Crane	735
Lon R. Smith	732
C. F. Scott	734
Scattering	2

For Member of the Council
(To serve for 1 year)

W. R. Strickland	737

For Treasurer

C. B. Whittelsey	737

TREASURER'S REPORT

Treasurer Whittelsey reported that the Society's finances are in unusually good condition. During the past years, up to Dec. 31, 1921, a surplus reserve of $134,251.74 has been accumulated, the greater part of

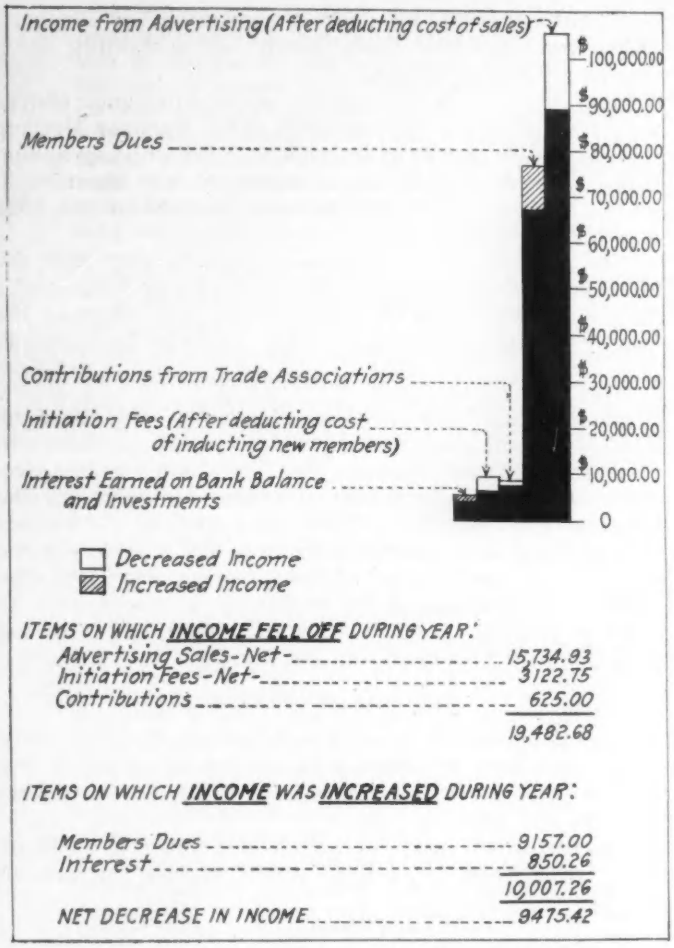


FIG. 1—INCOME COMPARISON FISCAL YEARS 1919–1920 AND 1920–1921

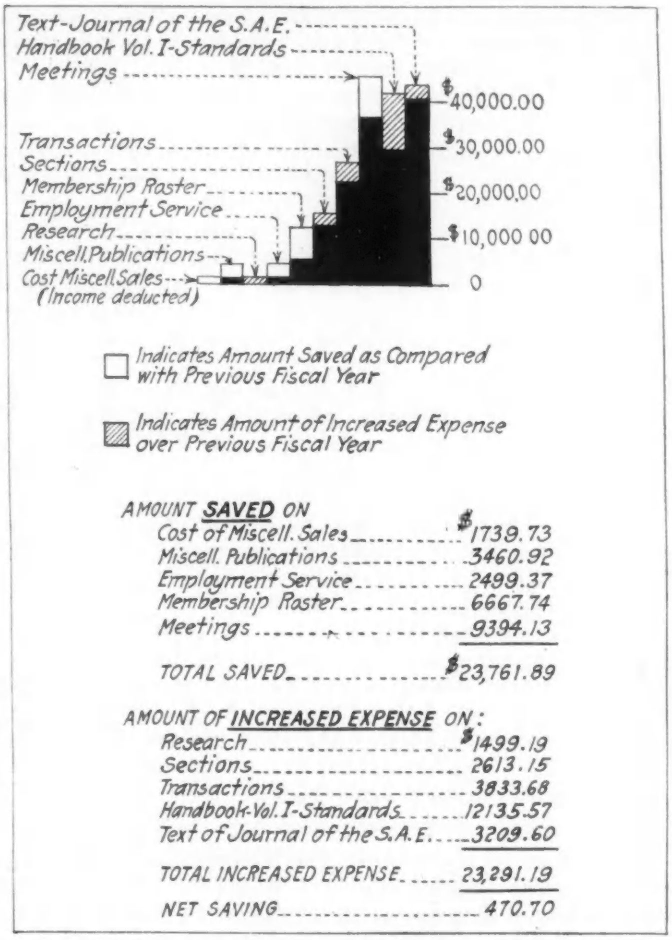


FIG. 2—EXPENSE COMPARISON FISCAL YEARS 1919–1920 AND 1920–1921

this being invested in sound securities. On Dec. 31 the Society had railroad and United States Government bonds and Treasury certificates of a par value of $100,000, the market value of which was $96,192.80. The average yield on all the securities is 4.74 per cent, which is considered excellent for absolutely safe investments.

Figs. 1 and 2 show graphically the relative values of the various items of income and expense of the Society during the 1920-1921 fiscal year as compared with the last previous fiscal year. It will be noted that the expense of the Society's principal activities was increased to the extent of $23,291.19, but that through careful management enough expense was eliminated in other departments of the organization to offset this increase. Owing to the general depression in business, the net income from advertising was considerably less than for the previous fiscal year. This loss was partly offset by an increase in the membership, with a consequent increase in members' dues. The unexpended balance of income over expense was $9,475.42, compared with $19,556.12 for the previous fiscal year. The Society's advertising revenue reached its lowest point in October. Since that time the income from this source has increased steadily.

The total income per member, after deducting cost of sales, was $34.32, compared with $41.69 for the previous year, and the per-member cost, after deducting income from meetings, was $32.57, as against $37.50 for the previous year. It will be noted that the cost of each member to the Society is more than twice as much as the dues he pays. This is made possible principally through the revenue received from advertising in THE JOURNAL, which redounds to each member and the automotive industry as a whole in the form of more and greater Society activities.

Treasurer Whittelsey was not so optimistic about the coming year and emphasized the necessity of thorough cooperation on the part of the members and the industrial leaders with the Society's affairs in keeping up the items of revenue and the prompt payment of dues. For the first three months of this fiscal year, from Oct. 1 to Dec. 31, the expenses have exceeded the income by $4,324.79.

At the organization meeting of the 1922 Council it was felt that the Society must continue its policy of constantly broadening the Standards and Research work, and to provide necessary current funds for greater activity along these lines it was thought wise to eliminate certain other expenses. The decision reached was to eliminate the greater part of the expense of printing and mailing the Society TRANSACTIONS and the Membership Roster and at the same time continue to make them available to those members who wish to have them. In future the TRANSACTIONS will be available to members who order them at $2 per part. Sufficient notice will be given so that members can order them before they are printed. The Roster will be reduced in size to an alphabetical list only and will be distributed to those members who request it after they have been notified that it is available.

BODY ENGINEERING SESSION

The Body Engineering Session repeated with increased measure the success of the first meeting of the kind held

in January, 1921. This year's attendance was very gratifying in point of numbers and included a large representation of engineers whose activities are confined exclusively to body design and production. E. G. Budd, who was chairman of the session, opened it with a short statement of the Society's work along body standardization lines during the past year and emphasized the need for most active and impartial cooperation in the future to assure the continued success of such standardization. The Passenger-Car Body Division has proved to be one of the more active Standards Committee Divisions, but Mr. Budd expressed the belief that the surface had been merely scratched in a field replete with possibilities. The paper by George E. Goddard on Body Seating-Dimensions was received with the interest anticipated and brought out the fact that body engineers are fairly well agreed on what practice it is best to follow in establishing seat-heights, seat-depths, leg-room and similar basic dimensions. J. E. Schipper emphasized the importance of providing sufficient room between the steering-wheel and the rear upper corner of the left front door-opening in order that the driver can enter and leave the car easily without disturbing his companion in the front seat. George W. Kerr called attention to the lack of room on the toeboards of most cars for the driver's left foot when the clutch is not being operated. Mr. Goddard's suggestion that a manikin be standardized for use in establishing seating dimensions met with general approval. J. Ledwinka stated that he had devised and used such a manikin with satisfactory results. Mr. Goddard urged the body engineers to forward suggestions for use in developing a standard manikin to the Passenger-Car Body Division of the Standards Committee at the Society headquarters, as the Division will undoubtedly undertake this task during the year. P. W. Steinbeck illustrated and described a new type of open-car enclosure in his paper on The California Top. In this design the windows slide back and are stored in the rear quarter of the top instead of being detached and stored in pockets when not in use.

R. S. Quaintance presented the salient points in his paper, Harmony in Car Upholstery, with the aid of color charts that emphasized the harmony between certain colors and the lack of it between others. In response to questions in the discussion Mr. Quaintance stated that he believes blue is the most popular paint color, with gray second. It was his personal feeling that brown is the most desirable color for a closed car, because it carries sufficient red to leave an impression of warmth. He said that the selection of totally neutral colors, such as gray or black, is ultra-conservative and to be discouraged when the owner's individuality receives consideration. When asked about susceptibility to fading, Mr. Quaintance stated that blues are most liable to be affected, red and green following in order. George W. Kerr expressed the opinion that insufficient care and poor taste are used too often in selecting exterior color-schemes to match the interior upholstery of bodies. He gave examples of color combinations that are not necessarily complementary or in agreement with the color scale but pleasing to the eye. George Mercer raised a point regarding the proper display of upholstery samples and called attention to the disappointments resulting from selections made from small samples. Mr. Quaintance said that it is difficult to secure an exact impression of the appearance of any fabric in the completed car from either large or small samples and suggested the trimming of a sample body as the only certain method when the quantity to be produced warrants this expense. In closing, Mr. Quaintance advanced the thought that one of the serious mistakes of merchandising is not providing for a choice in the selection of car interiors for closed-car purchasers. Several options should be offered to the people of differing personality.

The paper on the Manufacture and Application of Automobile Varnishes and Paints, by L. Valentine Pulsifer, was one of the most interesting and instructive of those presented at the Annual Meeting. In the discussion Mr. Pulsifer brought out the serious variation in coat thickness resulting from the flowing-on method of varnish application, illustrating his remarks with sample glass panels the coating-thickness of which had been measured. He described the methods used in measuring coat thickness and also the manner in which the elasticity of the several coats was determined and how it should be graduated. The use of a flat rub-out was recommended as the most satisfactory means of producing dull-finish effects. Mr. Pulsifer's experience has shown that in forced or heat drying the temperatures should not exceed 150 to 175 deg. fahr. and that less heat should be used with each succeeding coat. When drying the final flowing coat of varnish there is little to be gained by using forced drying. As a matter of fact, it results only in dimming the luster. Mr. Pulsifier believes that the spraying system is very suitable for the application of primers, rough stuff and flat color, but contended that the spraying of varnish coats has never been accomplished satisfactorily. The need for a thorough cleansing of all metal paint surfaces was stressed and in closing some of the chemical reasons for paint failure resulting from fading were stated.

Lubrication Session

The subject of lubrication, the different kinds of lubricants and their desirable and undesirable qualities bears a close and important relation to the production and satisfactory utilization of liquid fuels. The internal-combustion engine is almost as insistent in its demand for good lubricants to lessen its mechanical friction as it is in its demand for good liquid fuel.

That the necessity for good lubricants and good lubrication in engines is realized fully by automotive engineers was made plain by the extensive research work that was summarized in the able papers that were presented at the Lubrication Session and by the close attention paid to all details of their exposition. H. C. Mougey presided.

The paper on Viscosity and Friction had been printed[2] previously and was presented in outline only by the author, Winslow H. Herschel, of the Bureau of Standards, so that more time might be available for its discussion. Among the questions discussed were the connection between viscosity and friction in regard to the amount of clearance in a bearing; what constitutes the quality known as "oiliness" in a lubricant; interfacial tension between the oil and the metal; surface tension; the thickness of oil-films; mineral oils and the addition of fatty oils thereto. The statements were made that the amount of variation in lubrication effectiveness due to differences in bearing clearances is not yet fully determined; that "oiliness" is the property that causes a difference in the friction when two lubricants of the same viscosity at the temperature of the oil-film are used under identical conditions; that interfacial tension is an interaction between the oil and the metal; that surface tension has little effect; that very little experimental work has been done to determine the thickness of oil-films; and that, since there is slight difference in mineral oils as regards

[2] See THE JOURNAL, January, 1922, p. 31.

oiliness, organic substances are necessary at times to increase this effect. The need for some method of test to determine when an oil has been refined sufficiently, so that it is neither over- nor under-refined, was emphasized, and mention was made of the lubricating properties possessed by an oil of light viscosity, but having great oiliness, obtained from petroleum-base shale-oils having a large content of unsaturated hydrocarbons.

The relation between fluid friction and transmission efficiency, which was the subject of the paper presented by Neil MacCoull, of the Texas Co., is one concerning which small appreciation is evidenced in the related literature, there being a lack of necessary data regarding the variable factors of automobile friction-losses such as the quantity and viscosity of lubricants, the efficiency of worm-gearing and part-load modifications. Experiments to determine the mechanical losses, including all friction losses between the working gases in the engine and the driving wheels of the vehicle are described in this paper, and supplementary data are included from Professor Lockwood's experiments at Yale University.

Three distinct possibilities for increasing the fuel economy of a motor vehicle are specified and enlarged upon, gearset experiments to secure and develop data for a four-speed gearset being described and commented upon at length; photographs and charts illustrative of the equipment used and the resultant data are included. The effects of varying the speed under no-load and load conditions are studied, inclusive of mathematical analysis, and the efficiency of the gearset and noise measurements made in regard to it are discussed.

An interesting item of information was mentioned by Professor Lockwood, during the discussion that followed, to the effect that preparations have been made by the University of Kansas to study wind-resistance by mounting motor vehicles that are under consideration on a raft that floats on a lake that is often subject to high winds. The raft enables the vehicle to be turned to face whatever wind may blow, the expectation being that this will afford many advantages over wind-resistance studies made in wind-tunnels.

The paper by Robert E. Wilson and Daniel P. Barnard, 4th, on the Mechanism of Lubrication, presents the general theory of "greasy" and fluid friction, and partial and complete lubrication, and points out that all the customary quantitative tests and specifications for oils are designed mainly to meet conditions of fluid friction where the motion of the bearing carries and maintains a film of liquid between the metal surfaces. It was stated that the present specifications for lubricating media are illogical and inadequate and that tests should be developed that will measure the comparative value of the lubricant under conditions of partial lubrication. Such tests would be invaluable, not merely to the users of oils in choosing the one best suited to their needs, but also to the producers in affording a sound method of determining the value of various processes of refining and blending their products. Several possible methods of measuring the value of an oil under such conditions are considered, some of the essential results obtained therewith being discussed.

The importance of fundamental experimental work to determine the precise mechanism of lubrication and the composition and structure of the film that is effective in partial lubrication is emphasized. The hypothesis is offered that the latter consists of a plastic or gel-like solid rather than a liquid film that is produced by the selective absorption of certain constituents by the solid surface. These constituents are believed to be of a colloidal nature, and to constitute a comparatively small proportion of the greater number of mineral oils in common use.

An extensive research program has been undertaken at the Massachusetts Institute of Technology to study some of these fundamental aspects of the mechanism of lubrication. Certain new methods of investigating lubricating films are described in detail, with comment on the preliminary data obtained. In general, the results appear to support the hypothesis of a plastic solid film composed mainly of certain colloidal constituents in the oil.

The discussion following this paper related to the subjects of glycerized lubricating solutions, fatty acids, adsorption, the effect of the porosity of bearing surfaces such as cast iron, and kindred details. Much interest was manifested in the definition and thorough understanding of just what constitutes "oiliness" in a lubricant. The papers and discussions were replete with informative data.

Motor-Truck Transportation Session

At the technical session on Wednesday afternoon dealing with the problems of motor-truck transportation two papers were presented; one by Walter Jackson, dealing with the Past, Present and Future of the Motor Omnibus, and the other by M. C. Horine on the Economics of Motor Transport. In presenting his paper Mr. Jackson dealt almost entirely with the present uses of the motor omnibus in jitney service for cross-country work as a substitute for interurban electric railway lines or as supplementary service to existing street railways. He brought out the fact that the rate of fare will exert a marked influence on the ability of the motor omnibus to compete with the electric railway and stated that 10 cents is the proper charge for a high-grade motor-bus service when the average length of ride exceeds 3 or 4 miles and that the only opportunity afforded for a 5-cent bus-fare is where the length of ride does not exceed 2 miles and the buses are operated by one man. Another point made by Mr. Jackson is that, while many estimates for motor-bus operation show a cost of 1 cent per seat-mile, inclusion of all the legitimate items increases this figure at least 50 per cent and possibly doubles it.

In opening the discussion C. M. Manly spoke of the effect of transportation facilities upon suburban real-estate development and said that the possibility of motor-bus facilities being curtailed to some extent exerts a retarding influence upon the purchase of land in communities that are dependent upon buses only, while this is not true to so great an extent in the case of communities served by electric railways. At the same time he stated that he realized that the mobility of the bus and its consequent ability to change the routing if conditions make this desirable at any time help to secure the interest of capital in motor-bus companies. Herbert Chase questioned the cost figures given in the paper, asking if upkeep and capital expense were included and stating that he did not see why the cost per seat-mile in a bus should be twice that of the street railway. Also, he did not concur in Mr. Jackson's opinion that the street railways are best for the cities. In response Mr. Jackson said that the seat-mile cost was based on operating costs only in both instances.

T. H. Marburg mentioned the possibility of utilizing the trackless trolley-car as a transportation medium instead of the motor-bus or the conventional electric railway car. A. J. Scaife stated that the trackless trolley has the same disadvantage of fixed routing that a regular street railway has. He said that the ability to reroute buses in case of traffic blocks or changes in transporta-

tion conditions is a great advantage for the bus. He also mentioned the congestion of traffic caused by regulations in a few of the larger cities requiring vehicles to come to a halt when the street railway cars stop to discharge or receive passengers. G. A. Green agreed with Mr. Scaife that the trackless trolley lacks the flexibility of the motor-bus and also pointed out that the wiring must be installed before the route can be operated. The cost of the overhead structure of a trackless trolley system is, he stated, from $6,000 to $10,000 per mile; in other words, it costs practically as much to install a mile of trackless-trolley system as to purchase a single vehicle.

C. T. Myers said that the upkeep costs of motor-bus systems are, so far as he had been able to learn, high. He attributed this to the high repair-costs, which he argued were due to insufficient lubrication. He stated that, based on a charge of 50 cents per hr., the lubrication of the motor vehicles in operation in the United States at the present time costs $500,000,000 per year, assuming that 2 hr. per week is required for each vehicle. This he claimed is excessive as, if the chassis were designed for proper lubrication facilities, only ½ hr. every two months is all that each vehicle would require. Mr. Green, in reply to Mr. Myers, stated that proper lubrication is a relatively simple matter and that in reality there is not much difference between the motor-bus and the trackless trolley on this point. He said that the practice of the Fifth Avenue Coach Co. is to lubricate each bus after each 2000 miles of running and that, due to the employment of hollow shafts and members whereever possible, only 15 min. is required.

H. W. Slauson emphasized the necessity for protecting the motor-bus not only by legislation but from restrictive legislation. The conflict between the enactments of the 48 State legislatures and the numerous municipal and county ordinances is a serious problem. L. C. Porter called attention to the lack of illumination in the buses and said that the companies should do everything possible to forestall legislation along this line. He pointed out that, while lighting is provided for the comfort of the passengers, it also possesses advertising value. He felt that the dome lights that are used in the majority of buses are inefficient and recommended that lights with suitable reflectors be employed, even if this makes it necessary to increase the headroom.

E. C. Pohlmann spoke of the conditions surrounding motor-bus development in Chicago where five different municipal bodies have endeavored to regulate operation. The pioneer motor-bus company, he stated, operated for 3 years and then went into the hands of a receiver who continued for the same length of time and then sold out on the basis of 25 cents on the dollar. A number of viaducts were located along the line of one motor-bus route in the southern portion of Chicago and these necessitated the design of an entirely new vehicle. Mr. Green said that the necessity for keeping the center of gravity low to prevent overturning, for clearing overhead structures and for good appearance demanded that the headroom of the bus be kept as low as possible. In reply to Mr. Porter's criticism of the illumination in buses he stated that work on new generating apparatus is under way and he felt certain that better illumination for buses would be available within a year.

Mr. Chase asked if anything other than size inherent in a motor-bus makes the seat cost higher than in the street car and added that one explanation might be the upkeep. He also inquired whether a special type of chassis is necessary for a motor-bus or if it is possible to utilize the truck type of chassis as produced by several companies. R. E. Fielder in answer to this last question stated that the minimum width for bus bodies is 7 ft. and that the load is concentrated around the edge of the body, especially when the bus is equipped with longitudinal seats and to a certain extent when the small transverse seat is employed. The desirable width of chassis for motor-bus work is at least 14 in. greater than that of the standard truck chassis. Another point that operates against the use of truck chassis is that the floor of the vehicle should be as low as possible. The truck chassis is from 36 to 40 in. above the ground and inasmuch as from 10 to 12 in. is as high a step as a passenger can make comfortably, it is necessary to have three or four steps, which takes up all the platform space, or use a special chassis. Mr. Marburg stated that the cost of the electric railway is divided into the four general groups of maintenance, wages, power, and interest and depreciation, some of these being proportional to the mileage operated. In the case of the bus the investment per seat-mile is much less than with the street railway and the operating expenses are proportional to the seat mileage. The upkeep of the street railway car is much less than that of the bus and the cost of the electric current used to supply power is less than that of gasoline. Mr. Green, in continuing the discussion, said that for units of the same size the bus should not cost more to operate than the street railway car, but that the possibilities for overloading the latter reduce the cost of its operation to a very material extent.

F. W. Perry, representing the Department of Plant and Structures of the City of New York, spoke of the public emergency that made it necessary for the city to operate motor-buses, street railway lines and trackless trolley-cars. In his opinion no competition is involved between these three forms of transportation. He pointed out that the load per passenger-mile is heavier in the case of the trolley car than of the bus. N. G. Shidle stated that one factor that perhaps has retarded the development of the motor-bus in this Country is the necessity for the manufacturers being sure of an output for their product before beginning work. In England the motor-buses are operated by the tramway companies, and that is true, he thought, to a large extent in this Country. Both forms of transportation have particular fields in which they are most efficient, and for the so-called middle zone special studies must be made to determine which is the more efficient and economical. A special type of chassis is necessary for motor-buses. The competition of buses with cars from the standpoint of riding comfort and lighting was touched upon by Mr. Scaife, who said that the average jitney is rough-riding, uncomfortable and poorly lighted, due to the placing of practically any form of body on a truck chassis. He agreed with other speakers that a special type of chassis for motor-bus work would be developed.

J. E. Hale cited several factors that enter into the question of whether motor-buses should be used for transportation in any given situation. These were the cost to the rider, the maintenance of schedules, speed, safety of operation and the reluctance to permit the operation of street-railway lines in residential districts. Aside from the question of cost, the most important point is whether the bus can transport passengers more quickly than street railway cars. In this connection he brought out the fact that where jitneys compete with established street-railway lines they are preferred to the cars on account of the speed at which they transport the passengers. He said that in a number of cities railway companies also furnish electric light and power and that if the

motor-bus displaces the electric car as a mean of transportation there is a question as to what effect this would have upon the electric-light and power service of the communities involved.

Practically every speaker who participated in the discussion of the paper on Economics of Motor Transport, by M. C. Horine, emphasized the necessity for taking steps to prevent the enactment of legislation restricting the operation of motor trucks. In presenting his paper Mr. Horine pointed out that the amount of traffic is not responsible for the deterioration of the road and that the impact of the moving vehicles is not as serious as was formerly considered. While legislation limiting the size of truck used to 7½-ton would affect only 1 truck in approximately 25,000, he felt that steps should be taken to prevent such restriction. Another point upon which he placed emphasis was that the motor trucks contribute more than their share of the expense of building roads in the form of license fees and various forms of taxation. In response to a question by Mr. Pohlmann as to the saving resulting from the operation of a truck over a good road as compared with a bad one, Mr. Horine said that while data on this feature had differed widely in the past definite figures would be available soon.

W. P. Kennedy stated that the type of spring suspension and the tire equipment, with reference to the work to be performed, are fundamentally wrong in the motor truck as at present constructed and suggested the use of progressive spring equipment to take care of any inequalities in the road and dual solid and pneumatic-tire equipment to function at heavy and light loads respectively as remedies for these conditions. He also pointed out the waste that occurs on account of the need for producing a great number of parts to take care of the wide range of truck sizes and recommended three capacities of truck, nominally rated at ½, 2 and 5 tons respectively, as a solution of the parts problem, as well as offering a remedy for construction and to aid in the regulation of taxation. In his opinion education of motor truck users is not possible. In concluding his remarks Mr. Kennedy made a rather radical suggestion in regard to the method of constructing roads. He pointed out that not only is there a waste in road-building inasmuch as it is a seasonal procedure, but that the methods also are crude. He advocated the building of a road in the same manner as an office building as a means of reducing the cost of construction. In his opinion it is perfectly feasible to build the road sections on a mass basis at all seasons of the year and transfer them to the place of application after the subgrade has been prepared. In reply to this suggestion Mr. Perry said that it is not possible to build roads and buildings entirely in the shops and gave it as his opinion that 90 per cent of the road is in the foundation and its drainage. While it is perfectly feasible to build the wearing surface, which could be renewed, in the shop, this surface must be in sections of such size as to be readily handled by one man. If the foundations were properly built and drained, there would be no trouble about the roads wearing out. He also spoke of his observations of the French roads that have steep shoulders to carry off the water so that it does not get into the bed and cause damage. In conclusion he stated that as a general proposition the foundations are too weak for the loads carried by the roads. Mr. Pohlmann, in reply to the suggestion that certain standardized sizes of truck be built, said that the engineer must work out units that meet public opinion and fulfill the requirements of traffic. J. F. Winchester stated that while large trucks have damaged the roads, this has been due to the overloading of trucks as a result of sales propaganda. He advocated a wheel-load limit of 800 lb. per inch of tire width as being reasonable from the viewpoint of the operator of motor vehicles and also as a load that will not damage the roads. He felt that, although pneumatic tires are efficient from a road point of view, they would not compete with either the solid or the cushion tire.

H. M. Rugg emphasized the need of a trained personnel to operate the motor trucks and said that while 400,000 men are required to maintain the motor trucks in operation at the present time, only 225,000 are available and that of this number not over 40 per cent are trained or capable of performing the work that is assigned to them. He urged that engineers set a standard of training and education for motor-truck operators and repair-men and pointed out that it is only by the continual application of their knowledge of motor-truck construction that these two classes of men become experts. F. W. Davis said that the industry is faced with the fact that legislation is in process of forming that will react on the development of the motor truck. He felt that roads must be protected and classified as regards the load than can be carried, with certain seasonal variations now in force in some States. He mentioned the Connecticut motor-vehicle law which the truck builders had opposed when it was first enacted, but now considered a means of salvation that the industry had sought. The passage of similar laws throughout the United States would aid the motor-truck builder in his efforts to produce a vehicle capable of carrying the desired load and yet meet the whims of the user regarding the load to be carried, by setting a standard for the motor-truck builder to conform to. While large trucks are in the minority, a safe limit must be placed on trucks to be operated in fairness to the public who furnish the money for road construction. In this connection Mr. Davis stated that the load per inch of tire width or the load to be carried by a single axle is a workable basis. In conclusion he pointed out that, while motor trucks are essential on the highway, the industry should endeavor to secure legislation that will not be unduly restrictive and at the same time avoid the carrying of excessive loads. Such a course, he felt certain, would result in the securing of a greater mileage of improved roads without serious opposition on the part of the taxpaying public.

In closing the discussion Mr. Horine pointed out that the banishing of heavy vehicles from the roads by legislative enactment was a violation of American justice and not supported by scientific facts. While he thoroughly endorsed the scheme of classifying roads according to the load to be carried, he felt that this should be on the basis of traffic requirements rather than the present condition of the road. The economy of the motor truck is not measured by its capacity but there is a need for vehicles capable of carrying heavy loads. In connection with the remarks of the various speakers on restrictive legislation he stated that any legislation to be enacted should restrict the possibilities of the truck to damage the roads rather than its load capacity. He also stated that Mr. Kennedy's suggestion regarding three standard ratings for trucks is practically what is available at the present time.

Research Session

In opening the important Research Session toward which the many members of the Society privileged to attend had been looking forward with much interest, Chairman H. M. Crane prefaced his introduction of the eminent British automotive engineer, Harry R. Ricardo,

who read his comprehensive paper on Recent Research Work on the Internal-Combustion Engine, by saying that since the success of the Society has been due to cooperation, and since the presence of Mr. Ricardo was proof that cooperation in the automotive industry was international in character, the word "cooperation" might well become the Society's motto and slogan.

The large auditorium of the Engineering Societies' Building was used for this session, which was devoted entirely to the presentation and discussion of Mr. Ricardo's paper, and much enthusiasm was manifested by the large audience present.

The paper describes the research work on the internal-combustion engine done recently in Mr. Ricardo's laboratory in England, and presents his deductions therefrom, based upon an analysis of the evidence he has obtained to date. Fuels are discussed at length under three specific headings, many tabular data being included and commented upon, and the calculation of thermal efficiency is described. Mean volatility and detonation are discussed and the author's present views regarding turbulence are stated, this being followed by a brief summary of the conclusions reached by Mr. Tizard, a colleague of the author, following recent investigations.

The influence of the nature of the fuel upon detonation is presented, a lengthy discussion of the subject of stratification being given under three specific divisions, inclusive of comment upon the benefits derived from using weak fuel-mixtures. The paper itself is concluded with a discussion of turbulence with reference to combustion-chamber design, many charts and photographs having been included throughout.

The paper is supplemented by nine appendices, which include discussions of mechanical efficiency, under three specific headings; piston experiments, inclusive of four specified deductions; air measurement, with a description of equipment and methods; the total internal energy of the working fluid over a wide range of temperature; the influence of the compression-ratio upon the power output and efficiency; the influence of cylinder size on the performance; the influence of cylinder temperature on the power output; the distribution of heat in a high-speed internal-combustion engine; and the efficiency of a single-cylinder engine under reduced loads. This supplementary information is copiously illustrated.

Following the hearty applause that was accorded the author when he had concluded his presentation, this being given while the entire audience was standing in token of their appreciation and thanks, Chairman Crane remarked upon how difficult it is to comprehend the immense amount of creative thought and arduous labor that are involved in so exhaustive a treatise as this.

The exposition of so vast a subject as is presented by a full consideration of all factors relating to the internal-combustion engine is naturally provocative of wide differences of opinion in regard to some of its many phases, and the discussion became unusually snappy at times when some of these differences in belief were expressed. But, as was pointed out by Prof. O. C. Berry, this is exactly the desideratum of engineering convocations and he therefore advocated that automotive engineers descend from any possible pedestal of false modesty or false dignity, express their ideas fully and clearly in open forum whenever they have opportunity, and thus obtain the great benefit that follows a full and free interchange of thought.

Interest appeared paramount regarding present ideas concerning flame propagation, detonation and turbulence but other interesting factors also were much in evidence. The pros and cons of the introduction of exhaust gas into the cylinder were expressed briefly and a description of tests made with bombs to determine the ignition point of any fuel, made by the Bureau of Mines, was given. The arrival at some standard method of computing engine data, so that the necessity for any recomputation can be eliminated when different experimental data are to be compared, was advocated and it was suggested that the Society make an effort to accomplish this.

The effect on detonation of carbon on the piston and the cylinder walls was related and the experience of the Fifth Avenue Coach Co., New York City, with the Ricardo slipper-type piston was described and illustrated by lantern slides.

Questions were asked relative to the effect of spark-advance on detonation, what means can be used to determine when detonation does and does not occur, what the viewpoint of English engineers is in regard to dissociation and other pertinent topics; but, since the replies were made by Mr. Ricardo as a conclusion of the discussion and since the full text will be published in an early issue of THE JOURNAL, no attempt is made here to more than indicate the trend of thought during this session.

[As Mr. Ricardo desires to make some corrections in his paper, as preprinted, it will be impossible to publish this paper in THE JOURNAL for February as was intended. Members who desire to secure a copy of the uncorrected preprint of the paper, of which a limited stock is on hand, can do so by communicating with the Society's office in New York City.]

AUTOMOTIVE MATERIALS SESSION

At the Automotive Materials Session held on Thursday afternoon the discussion related principally to the metallurgical phases of the papers presented. With reference to the paper by C. N. Dawe on Chrome-Molybdenum-Steel Applications from the Consumer's Viewpoint, R. H. Sherry pointed out that the chrome-nickel physical-property figures given were low and suggested that a chrome-nickel steel containing 0.35 per cent of carbon be used to make a comparison. In reply to this suggestion Mr. Dawe said that it is perfectly feasible to use a 0.35-per cent carbon-steel or a steel of the S.A.E. 3200 Series and get a merit index that would differ in form from the curves shown in the paper but still bear a general relation to them. Mr. Sherry said that he did not believe in the merit index as a means of determining the use of a steel for automotive purposes and in this contention he was supported by J. H. Nelson, who said that in his opinion the merit index is a far from satisfactory guide. He also suggested the addition of Brinell hardness numbers to the tables presented in the paper as affording a means for making a comparison, and stated that from a production standpoint machinability must be secured even though the hardness of the steel be reduced in the attempt. He took exception to the statement of Mr. Dawe that the reduction of area of a steel and the impact test results bear a definite relation to each other. J. D. Cutter agreed with Mr. Nelson regarding the merit index and said that it could not be used to compare tests made under different conditions, although the curves in the paper possessed some merit as affording a means of comparison. In response to a question by George L. Norris as to how steel produced with calcium molybdenate compares with that in which ferromolybdenum is used, Mr. Cutter said that equally good results are obtainable with either but that, so far as he knew, no steel in which calcium molybdenate was used had been produced in the

last year and a half. In concluding the discussion Mr. Sherry endorsed Mr. Nelson's suggestion regarding the addition of the Brinell hardness-numbers and stated that this is necessary to meet commercial specifications in which the hardness numbers appear.

In discussing the next paper by G. R. Norton on Continuous Die Rolling, Mr. Nelson said that this process is interesting and can be made useful in connection with drop-forging. While the use of this process would save time in the forge-shop, it would restrict raw material, particularly on small jobs.

The paper by J. H. Nelson on Drop-Forging Practice aroused the most discussion of any paper at the session. Mr. Sherry asked if the use of a lead pot of say 24-in. diameter and from 6 to 7 ft. long would not do away with the variation in the Brinell hardness mentioned by Mr. Nelson. Mr. Nelson said that in his opinion the physical properties are a function of the temperature and not of the means by which this temperature is obtained. The furnaces used in making the tests reported in the paper were checked carefully with six pyrometers before being used on production work and a variation of only 5 deg. or less was permitted between the pyrometers. Mr. Sherry reported that in his experience the variation in hardness with the lead pot is small as compared with a furnace in which six and even eight thermocouples are used to control the temperature and that the lead pot possesses the additional advantages of a lower cost and the securing of a more uniform product. W. F. Graham commented on the accuracy with which the temperatures in the furnaces mentioned by Mr. Nelson were maintained but endorsed Mr. Sherry's views on the use of the lead pot, saying that quenching and drawing in the lead pot give accurate results on forgings. In his opinion the variations in the Brinell hardness mentioned were functions of the carbon and the manganese contents; he thought that the percentage of these two elements must be given consideration and the drawing temperature varied accordingly. In continuing the discussion Mr. Nelson said that the manner in which the temperature is raised has a decided effect on the making of steel. In response to a question by H. J. Stagg as to whether the differences in the raw material could not be ascertained and used as a basis for predicting the results obtained, Mr. Nelson agreed that it is possible to detect the differences but could not state their effect. He added that steels of supposedly identical composition from different mills require different heat-treatments. In support of Mr. Nelson's last remark Mr. Dawe said that he had seen steel that was chemically and metallurgically correct that could not be hardened when first treated but that after gear-blanks produced from this steel had lain in the factory yard for 9 months satisfactory results were obtained. He believed also that the seasoning of gear-blanks in this manner would eliminate warpage in heat-treatment.

The need for good designing of malleable castings and the fact that better results can be secured by paying proper attention to the section of the castings were the two principal points brought out in the discussion of the paper on Pertinent Facts Concerning Malleable-Iron Castings, by Enrique Touceda. In answer to a question by F. P. Gilligan, who presided at the session, as to the willingness of automotive engineers to respond to requests from the foundries for changes in the design of parts for which malleable-iron castings are used, Mr. Touceda said that, while the willingness of engineers to respond to such requests had always existed, it had been particularly noticeable within the last two or three years.

Fuel and Engine Session

The paper on Manifold Vaporization and Exhaust-Gas Temperatures, by O. C. Berry and C. S. Kegerreis, was first on the program for the Fuel and Engine Session and was presented in outline by Mr. Berry. Most of the members who had manifested their interest by attending the Research Session gave evidence of a continuation of this interest by being present, and the representative audience was presided over by Chairman A. L. Nelson.

Stating that present internal-combustion engine fuel is too low in volatility for economical use and that this is the course of engine-maintenance troubles, Messrs. Berry and Kegerreis believe that, since it is not possible to obtain the more volatile grades in sufficient quantity, the only hope of remedying this condition is to learn how to use the heavy fuel, and that the most promising method of doing this lies in the effective use of heat.

As the experimental data regarding the best temperature at which to maintain the metal in a hot-spot manifold are meager and the range of temperatures available in the exhaust gases is narrow, the authors experimented in the Purdue University laboratory to secure additional data. Their paper presents a summary of the results.

They feel that the exhaust-gas temperatures are high enough for properly designed manifolds, together with thermostatically controlled carbureter temperatures, to make possible the satisfactory carburetion of fuels considerably heavier than the present "power" gasoline, without seriously limiting the power, efficiency or flexibility of passenger-car engines or causing any engine-maintenance troubles.

The paper by Thomas Midgley, Jr., and T. A. Boyd on Methods of Measuring Detonation in Engines[3] was read and commented upon by Mr. Boyd, who emphasized and amplified some of the statements contained therein. Among the points so treated were that three elements are of primary importance in a universal method for measuring the intensity of detonation. First, the method should embody a means for indicating the relative intensity of different detonation waves. Second, it should comprise means of integrating the intensities of individual waves over a period of time, and of yielding a numerical value that is accurate and can be duplicated when employing the same method. Third, a standard fuel should be used as a basis of comparison so that the results obtained can be repeated by different observers and under varying conditions. An amplification was made of the four different methods of measuring detonation that are considered in this paper, the listening, the indicator, the temperature and the bouncing-pin methods as described in Table 1, and the type of record that is possible in each case.

The paper on the Spectroscopic Investigation of Internal Combustion, by Thomas Midgley, Jr. and W. K. Gilkey, was enlarged upon by Mr. Midgley. It is designed to familiarize automotive engineers with the general subject of spectroscopy, pointing out the various methods that can be employed to determine the actual instantaneous pressures obtained in normal combinations, the temperature-time card of the internal-combustion engine and the progress of the chemical reactions involved in normal and abnormal combustion.

The subject of spectroscopy is outlined and explained first, illustrations being presented of different types of spectra, and spectroscopes and their principles are dis-

[3] See The Journal, January, 1922, p. 7.

cussed. The remainder of the paper is devoted to an outline of what the spectroscope can reveal about the nature of combustion.

The discussion that followed the presentation of each of these papers will be printed later in THE JOURNAL, and the papers by Berry and Kegerreis, and by Midgley and Gilkey also will be published therein. The discussion included an explanation by P. S. Tice of differences from some of the curves exhibited by Mr. Berry that he has obtained, and comments by Prof. R. E. Wilson regarding the subject of the end-point of fuels. Mr. Boyd answered the question as to how comparisons between detonation effects existent in different engines can be made by stating that this is accomplished by using a standard fuel for all such tests. Mr. Midgley gave further explanation of the different kinds and qualities of light in various portions of the spectrum, in answer to a doubt expressed by one of the speakers regarding the feasibility of using the spectroscope for investigatory purposes when pressure conditions are involved.

PASSENGER-CAR SESSION

It is a fact to be deplored that all finite good things must, at some finite time, come to an end. In this connection and as this report of the 1922 Annual Meeting of the Society approaches its conclusion, we must record that although the Passenger-Car Session held on the morning of Jan. 13, 1922, was the last of all the successful events of this eventful week, it was by no means the least successful. The informative and exhaustive treatises by J. Edward Schipper and S. von Ammon and the most interesting and in many respects novel paper by Prof. A. Trowbridge were a guaranty of this; but, to clinch the argument in favor of this session with staggered copper rivets let through the fabric from both sides and holes cut-punched and staggered for more, Past-President H. W. Alden was chairman of the session.

The paper on Passenger-Car Brakes was read in outline by the author, Mr. Schipper. He stated that the problem of deceleration is just as important and necessary of solution as the providing of car-acceleration ability, and then gave a comprehensive survey of present braking practice, together with an outline of future braking requirements and possibilities.

Design factors are considered at length in this paper, as well as the subject of what constitutes uniform and effective braking-power, various illustrations and descriptions of different types of brake being included. Brake-actuating means, the calculation of brake-drum size, car-stoppage ability, brake equalizers and brake-linings are commented upon in some detail.

The future of brakes is discussed with reference to the use of the engine as a brake, four-wheel and front-wheel brakes, the servo principle of brake operation and various novel braking methods. A brief summary of what is considered good practice with regard to truck brakes is appended. In many respects this paper bears the same relation to the subject of brakes as a previous paper by Herbert Chase on Practice and Theory in Clutch Design[4] bears to the subject of clutches.

The Bureau of Standards has been engaged for some time in developing a standard method for testing brake-linings, as a result of the general policy of the Motor Transport Corps to standardize the materials used for automotive vehicles for Army service, and has been co-operating with the Society and the automotive industry in this connection. Although the work has not been completed, much information has been gained and the paper on Developing a Method for Testing Brake-Linings, written and presented by S. von Ammon, reports the progress that has been made.

The equipment developed and the methods used for both main and supplementary tests are described. Data are given regarding the coefficient of friction, as influenced by various factors. The endurance test, showing the comparative behavior of linings under conditions similar to those of severe service, is believed to be satisfactory as developed. Further work is necessary before recommending the conditions for the other test, intended to determine the relative endurance under ordinary or light service. In work done thus far with a cooled drum and over a very wide range of power absorption and speed, difficulties arising from the accumulation in the linings of particles of steel cut from the drum have persisted. Supplementary tests covering the tendency of a lining to stick when brakes are left applied on a hot drum and to ascertain the relative absorption of oil and water are described. The influence of oil and water on the coefficient of friction is shown.

In his paper on the Photographic Recording of Engine Data, Prof. A. Trowbridge, of Princeton University, states that until a few years ago he shared what he believes to be the general feeling among technical scientific men, that photographic methods of recording experimental data, such as pressure-volume variations in an engine cylinder, vibrations of shafting and motion or timing of valves, could not be rendered sufficiently simple to be reliable in the hands of the ordinary intelligent mechanic; but that an experience of 2 years in France during the war convinced him that photographic recording is the quickest, cheapest, most foolproof and cleanest method there is.

After illustrating and describing the camera and automatic devices that were developed for, and successfully withstood, war usage, Professor Trowbridge outlined many possible uses for this apparatus in the securing of engine data, especially with regard to securing data that ordinarily are obtained from high-speed indicators, and showed how the parts of an indicator-card that are on too small a scale for accurate interpretation can be enlarged or spread out by this photographic method to permit close analysis. It is planned to reproduce with his paper in an early issue of THE JOURNAL the lantern slides that he used.

The time for the discussion of these papers was very limited and very likely its subject matter can best be reserved for detailed publication, except to say that much interest was shown in the relative merits and demerits of using the engine of a car as a brake, and that attention was called to the fact that only 4 to 5 in. of pedal travel is available for all ordinary braking effects.

Comparisons are invidious, irrelevant and uncalled for. The 1922 Annual Meeting of the Society is recorded upon the pages of history as having maintained a high standard of excellence, with its attendant accomplishment of scientific progress and social enjoyment. We feel that at no time during the passage of this eventful week was our marshalled army of cumulative progressive automotive-engineering data in any danger of being called upon to surrender to our good old military friend, General Average.

REDUCED RAILROAD FARES

Seven hundred and forty-nine reduced railroad fares were granted to members of the Society and those of their families who accompanied them to New York City.

[4] See THE JOURNAL, July, 1921, p. 39.

It is estimated that the average saving per person was $12, and the total saving about $9,000.

THE CARNIVAL

The Carnival of 1922 maintained in full measure the enviable reputation set by the unusually successful Carnivals of former years. The ballroom foyer of the Hotel Pennsylvania was transformed by scenic artists for the occasion so that it represented a bit of Coney Island set down in the heart of New York City. The man with the fortune-wheel and assortment of boxed candy was there in all his glory. The pop-gun shooting-gallery proprietor vociferously announced the possibilities of acquiring your favorite cigarette without cost; if your marksmanship met the test. The fortune-lady peered into the hollow of many masculine and feminine hands, predicting the destiny of the future and recalling milestones of the past. A line of the curious filed steadily past the crystal gazer in order that he might solve their riddles of the coming year or astound them with his familiarity with their most intimate thoughts. Free lollypops proved to be especially popular. Paper hats added color to the assembled picture, while horns, rattles and whistles provided the necessary clamorous background. The members who attended the Summer Meeting at West Baden were reminded keenly of the sad evenings at the establishment of the Brown family. The famous Keno Room was depicted faithfully in one of the halls adjoining the ballroom and there the Carnival Committee disposed of many attractive prizes at the will of the checkered card.

The dance in the main ballroom was the major feature of the Carnival of 1922, as in the case of its predecessors. Music of the present age and vintage was served to the trotters and steppers by a group of 12 exponents of modern ballroom symphony. The gentler sex were present in ample numbers, scintillating in the latest creations of the exclusive modiste. Dancing continued until the wee small hours when the barkers were silenced, Brown's lost its faithful adherents and all the Carnivalites pulled up stakes, unanimously voicing approval of the work of B. G. Koether and his associates on the Carnival Committee.

THE ANNUAL DINNER

Toastmaster Kettering said that the address of Arthur R. Marsh at the annual dinner was alone worth the trip of many members to New York City, and it was clear that the members in general agreed with him. The whole dinner was of a highly enjoyable and instructive nature. One pleasing phase was that Past-Presidents Vincent, Manly, Kettering, Huff, Dunham, Alden, Marmon, Coffin and Riker were seated at the speakers' table.

In remarks prefatory to introducing Mr. Kettering President Beecroft said:

We have reached what we might term a maximum of production, but we are yet far from the maximum of efficiency, from the maximum of economy and from the final word in the economic application of all the automotive equipment we are designing.

We hear talk about the saturation-point of the automobile or of the motor truck. I wish we could forget that and consider the saturation-point of transportation. We have not reached the point of saturation of transportation and there will be no saturation-point in any phase or department of the automotive industry until we shall have arrived at the economic saturation-point of automotive transportation. Reaching that economic saturation-point should be our objective.

I wonder whether we appreciate the position in which we stand; whether we appreciate how fortunate we are. We are the generation that has been handed literally the conquest of the air. What a coveted position in the history of the ages, with this last great, grand field of conquest placed on our lap! We can view other conquests in the transportation field in the same way. The burden that rests on our shoulders is correspondingly great.

REMARKS OF TOASTMASTER KETTERING

In taking command of the dinner, Mr. Kettering submitted as his uptodate version of the Grasshopper song the following:

> One gashopper cuts his price right under the other gashopper.
> Another gashopper cuts his price right under the other gashopper.
> They are only playing poker;
> They are all looking for the joker;
> And they are all going broker.

Continuing his narrative of current affairs he said that the engineering profession has been guided by people who have been especially ordained not to listen to anybody but themselves. Salesmen have become overnight engineers; advertising managers have made Ananias cry. He felt that it is time for the engineers to have an idea of their own and tell their executives and sales managers as well as any others that need to be told, just what a good automobile is if in their peculiar position they should happen to know what one is.

The automotive industry is just as basic as the bread-and-butter industry. It has entered into our civilization fundamentally. It is a great transportation activity. If ever the engineer had a real problem, it is today in trying to find out what the simplest practical thing is that he can design and build that will do the thing he wants it to do.

The engineer must be very much closer to his management than he has ever been before. He has been regarded as a more or less eccentric individual, and perhaps there has been some foundation for that. However, whenever two people think each other eccentric, there is perhaps a middle-ground; and whenever a financier, manager or salesman tries to dominate an eccentric engineer without analyzing exactly what he is trying to do, maybe he divides the responsibility.

The automotive indusitry is bound to stay. We have not started it yet. It is less than a generation old. The same essentials prevail that have been before us for a long while. We have reached a condition of economic balance. We are in a period of intense competition. It is axiomatic in any business that competition comes only when progress stops. All industries must go through such periods when they involve great capital investment. It is difficult to make a change.

The Society of Automotive Engineers must set a new standard of economic values. The only reason we have a second-hand problem today is that our new cars are no better than our second-hand ones. If we could make new cars immensely better than our second-hand ones, there would be no second-hand business. We are "saturated" for the simple reason that we have not made enough progress. We are only 3 years away from the war. Attribute the condition to that while you have the chance.

In introducing Mr. Marsh, the principal speaker of the evening, Mr. Kettering assured the members that they were about to receive the most important and constructive message they had ever heard. Mr. Marsh's ad-

dress certainly added greatly to the considerable reputation that has been attained by S.A.E. Annual Dinners as occasions at which the true industrial keynote for the respective years has been struck. It is thought that in clearness, pertinancy and forcefulness Mr. Marsh's talk has been rarely excelled. Nothing could have been more timely in the present condition of the automotive industry. Nearly every passage of his remarks, which are given in full elsewhere in this issue of THE JOURNAL, is worthy of close study. He said that, considering the farmers alone, there are at least 9,000,000 people in the United States who cannot afford to *not* have automobiles. He gave as an analogy that in years gone by every farmer had to have a horse, no matter what his income was. The economic uses of motor vehicles of one kind or another are of predominant importance. The joy-riding days of the automotive industry, as well as of car owners, are over.

The work of the automotive engineers is going to become much more important. The situation is going to be different, and it will not be an easy one. The railroads reached a stage 25 years ago where they had to be kept alive by the work of the engineer. The engineers alone have saved the railroads from utter ruin. The automotive engineers must bear the brunt of the pressure that is inevitable from the competition that rises to greatest intensity when an enormous product is demanded from the factories, but not enough product to fill the factories to capacity.

Mr. Marsh's theme was, How Are We to Know When Business Has Turned the Corner? The first factor is that in the long run the only way in which goods can be bought is by goods. Fundamentally, both actual money and bank credit are nothing. It is not by money or by credit that Europe can buy our goods, or that we ought to sell goods to Europe. Europe must buy our goods with goods. When the German mark was at its lowest and most demoralized, Germany was the largest buyer of cotton and copper in the United States, and of wool and tin in London. She did this by producing goods and getting them out into the world.

In Great Britain at no time since the war has production been as much as 60 per cent of what it was in 1913, in spite of the fact that there are in England more workers than there were in 1913. Banking credit and restoration of exchanges can be discussed interminably, but the situation will not be improved until people go to work and produce goods wherewith to buy goods. In the United States there are millions of men who do not wish to produce goods upon terms which the world can meet—and every industry suffers. The American farmer says, I cannot and I will not buy under present conditions. As was stated by George E. Roberts at the annual dinner of the Society last year, the real root of our economic troubles is that the equilibrium, the balance, between the producing and the consuming classes has been turned topsy-turvy by what happened during and since the war. Turning the corner means getting back to that state of balance which was the result of three generations of gradual adjustment under the stress of competition. The problems are working themselves out by a process of grinding which produces suffering in every direction. The urban population has received nearly five times the income the rural population has received, and yet the numbers of the two populations are identical. There is today, as compared with 2 years ago, a shrinkage of at least $6,000,000,000 in the distributable income accruing to the urban classes and workers in the United States from the cotton user in the United States alone. There is the same sort of shrinkage of a relative degree in the case of copper, iron and steel products, and of many other finished commodities.

This is the principal factor to consider in determining whether business is actually at the point of turning the corner. There are many indications that alleviation is at hand, although these are rather obscure. The best omen for the future is that in Europe production and consumption are rising steadily. With goods, goods can be bought.

In calling upon B. B. Bachman, whose term as President of the Society began at the close of the meeting, Toastmaster Kettering expressed the appreciation of the members for the excellent service Mr. Bachman had rendered as chairman of the Standards Committee and as a member of the Council for several years. He said that the remarkable spirit of cooperation in the Society and the automotive industry will solve the transportation problems facing the industry.

PRESIDENT-ELECT BACHMAN

The pleasure and profit that I had in serving on the 1921 Council under Mr. Beecroft were so great that I regret keenly that his administration is closing. As I measure myself against him and his predecessors, I feel deeply the responsibilities that I shall assume tomorrow. I do not find my vocabulary adequate to express my appreciation to you who have honored me so signally. It is my hope that, with the support of the other members of the 1922 Council, and the assistance of the permanent staff of the Society under Mr. Clarkson, I shall be able to justify the confidence you have placed in me.

I wish to add a word of appreciation to the gentlemen under whom I have had the pleasure of serving on the Council, and particularly to those who intrusted to my care the Chairmanship of the Standards Committee. Next to the Presidency, I think that position bestows more honor upon the holder, as well as more responsibility, than any other. That I was able to hold it down at all is due entirely to the loyal support of those of you who have contributed to the work of the Committee so generously of your talent and time. I wish also to acknowledge the cooperation of the efficient organization under Mr. Clarkson's direction, without which the detail work of the Society would be hopelessly neglected.

As I review the history of the Society I am reminded forcefully that the reason for our continued existence and growth is that we have served. This may seem to be a rather flat statement, but I am inclined to believe that the general overlooking of this elementary function is at the bottom of a great many of the troubles the industry has undergone recently. There is an old saying that "He who does no more than he is paid for, is never paid for more than he does." I can hardly believe that this principle is applicable only in hastening the lagging footsteps of the office-boy. Rather, it is a homely way of telling us that whoever we are or whatever we are doing, the task and its completion in an honest way must mean more than the reward, if we are to succeed. Is it not possible that in recent years profits have loomed larger than service to the manufacturer and the merchant? Have not wages seemed of more moment than increased efficiency to the workman?

The more I have thought the more strongly I have been impressed by the fact that to progress in the times that are ahead of us we must get back to fundamentals and measure our plans and purposes by the plain and commonsense yardstick, Service. This it is my purpose to do to the best of my ability with your assistance during the

coming year. We must, if we are to continue our growth and maintain our prestige, serve our members, particularly the younger men; for upon the engineer rests a large responsibility in solving many problems that are spread over the road our industry must travel in the coming years. To meet these responsibilities we must widen our horizon continually. It is essential that there be brought into the engineer's mind and into the drawing-room and the laboratory a clearer conception of manufacturing and merchandising. In other words, we must be more than technicians; we must be business men and view our problems from the commercial as well as the technical side. I know of no better way in which this viewpoint can be developed than by the contact that active participation in the affairs of the Society provides. Those of us who have been fortunate enough to attend the meetings of the Society appreciate this thoroughly; but how about the hundreds of younger men who do not have this advantage? The activities of the Sections provide for them in some degree, but it is possible that more can be done along this and other lines if we put our mind to it.

I have heard the statement that we would be better off if the Society had fewer members at higher rates for dues. In other words, that we should be more exclusive, and the Society become a Hall of Fame open to only those who have arrived. I believe that we should bring more earnest young men together and grow with them as they grow. This is our foremost mission. Next to it is our responsibility to the industry in finding solutions for the problems that confront it. Of these there are many, relating to features of design, to production, and to use in the hands of the public. Some of these we are competent to deal with alone; on others, we can act only as assistants. I believe, however, that the enlarged character of our meetings, the increased scope of Section activities, the present stature of the Standards Committee and the growth of the Research Committee are facts in evidence that we stand ready and equipped to cooperate with the commercial organizations of the industry in any way they may desire.

Finally, what is our duty outside the immediate circle of our industry? I am becoming more and more of the opinion that there is a tendency in modern affairs to over-organization on every side. I hope I am not too narrow in this belief, but I cannot help feeling that, although these movements are often praiseworthy from the standpoint of the motives that lie behind them, they result in a lowering of efficiency and a delay in producing results. In the work of an organization such as ours the members can be called upon generally for a small proportion of their time; in most cases too small, however, for them to handle effectively any details. The result is that the details must be attended to by the permanent staff of the Society, the size of which is governed by its financial resources. Overloading this organization results in reducing the individual and collective efficiency. I believe that under the prospective conditions of this year we must fix the responsibilities in our own field firmly in our mind and attend to our own knitting.

The organization of the Administrative Committees of the Society for the coming year is complete; and a type of mind that would willingly go along with mine was not a qualification that controlled the selection of the members of these Committees. On the other hand, I hope to be able to benefit by their advice in guiding the affairs of the Society. But I hope that we shall be united in making the motto for the year 1922; Service.

CROWBARS AND ECONOMICS

VERY few people who are earning their living know much about the fundamental science underlying business. There are many business men who insist on their machine designers and their bridge designers being thoroughly well grounded in the theory of physics, yet these same men may hoot at the idea that there can be any sense to economic theory. They look on economics as nothing but a lot of fine-spun notions existing only in the heads of college professors. Even a good crowbar artist in a quarry might look on physics in the same way.

The business man is using economics every day. He may be a real artist with his economics, and not know much about fundamental theories of economics. But to the extent that he is successful in his business he has applied economic theory properly. To the extent that he has misapplied it he has failed to reap the full benefit of his tugging and sweating on his own crowbar, and even may roll his business boulder over on himself.

Every year Bradstreet's publishes figures classifying failures according to their causes, and these statistics show that only from 11 to 14 per cent of all these failures are due to causes over which the men who fail could have no control. Most failures were due to causes that lay in the control of the men who failed. They used their crowbars wrong and toppled their business boulders on themselves. It would seem that for the 87 per cent who fail some better use of the theory of economics would no doubt be of very considerable assistance.

Failures destroy wealth as much as fires do. Our failure loss runs considerably ahead of our fire loss in a year. Between the two of them it is estimated that we Americans are destroying at the rate of nearly $1,000,000,000 of wealth per annum right now.

Under a free competitive system, which seems to be about the only one the world can work under, every man is free to take his chance—and he should remain free, but others should not be called on to pay the cost of his ignorance. A large amount of futile effort is wasted by ignorant men in getting out their business boulders. Many who do not fail completely waste a tremendous amount of business effort in their work. Economic education is the only palliative for this waste.—E. F. Dubrul in *American Machinist*.

THE INTERNAL-COMBUSTION ENGINE

THE history of the internal-combustion engine is of much shorter length than that of the steam engine, for it was not until the latter had been in use for over 50 years that a successful prime-mover using gas was produced. The advance made in design since the first combustive free-piston gas engine was hailed as epoch-making is well illustrated in the present-day high-speed engine producing 1 hp. for each 2 lb. of engine weight. The improvements in design have been followed by a more general use until at present there are in the United States at least five times as much horsepower in internal-combustion engines as in steam turbines and steam engines. The enormity of power of the steam powerplants in any State is completely overshadowed by the horsepower of engines using liquid or gaseous fuel. Furthermore, the annual production of the internal-combustion engine is increasing much faster than is the construction of prime movers employing steam as the source of energy such as reciprocating engines and turbines.—*Power*.

How Are We to Know When Business Has Really Turned the Corner?

By Arthur R. Marsh[1] ANNUAL DINNER ADDRESS

IN the highly complimentary introduction with which your toastmaster has favored me, he has perhaps omitted one of my more human qualifications. Coming from Boston is scarcely human; being a professor in Harvard is certainly not human; and what shall I say about being an editor? But in order that I may appear in a human light before you, I will venture to say before I begin my address proper that I am also a member of one of the best-known gambling institutions in New York or the Country—the New York Cotton Exchange. I say one of the best-known gambling institutions because the New York Cotton Exchange is commonly so designated through the South, in the halls of Congress and in various other influential quarters.

Some of you remember, no doubt, from the days of your childhood, that passage in Alice in Wonderland in which Alice tried to turn a corner and saw the corner perpetually a little ahead of her, but always just before she got there the corner straightened out and there was no corner to turn. I suspect that in truth we shall never know precisely when business turns the corner; that, after all, we shall go along the road seeing corners ahead which we hope to turn, but that, when we get there, we shall find there is no corner at all.

I am a little embarrassed by having been assured by your President and your Toastmaster that engineers in general do not care very much about economists or economics; that you do not know very much about economics and that you are not particularly interested in it. Perhaps I am doing these gentlemen an injustice in stating what they have said to me, but that at any rate was the impression I derived from what they said. I am therefore to tell from an economic standpoint, to a body of gentlemen who do not care about economics, when business has economically turned the corner, when there is no corner to turn.

I do not wonder much that a body of engineers, and particularly automotive engineers, should be a little doubtful about economics. You have not been paying much attention to the economists, but the economists have been paying a lot of attention to you, and some of the things they are saying about you, well, your own Toastmaster might have said them. That is as good a way of describing them as I can think of.

A few days ago I was reading the elucidations of an economist about the automobile industry. He has got you in very bad shape, in a very bad plight. He has discovered that nobody who has not an income of over $2,000 a year has any right to have an automobile. Having made that discovery, he set about finding out how many people there are in the United States who have an income of $2,000 or more a year. Naturally, he turned to the Treasury Department reports. He found that last year the number of persons who paid taxes on incomes of $2,000 or more was only 2,335,000. Then he found that last year there were 9,000,000 automobiles in the Country. 2,335,000 people in the United States whose means entitled them to have automobiles, and 9,000,000 automobiles; a really distressing condition of affairs.

Having got as far as that, the economist proceeded to discuss the question of saturation, which, I gather from what I have heard here tonight is a somewhat tender subject, and concluded that the United States is saturated to the extent of 5,000,000 automobiles at the present time.

If I may be flippant, I may remark that that is a good deal of a jag. "Now," says the economist, "with a population of 107,000,000 people, saturated to the tune of 5,000,000 automobiles, we have to add the further fact that 7,000,000 people in the United States are devoting themselves to the building of automobiles, to the manufacture of automobile parts, to the upkeep of automobiles and to the operation of automobiles." That leaves only 100,000,000 million people in the United States who are not engaged in the automobile industry. Again a rather serious state of affairs.

Then he goes further and remarks that the cost of these 7,000,000 people to the Country is 15.5 per cent of its entire income. In 18 years, such is the voracity of the automobile industry, it has arrived at a point at which it is absorbing 15.5 per cent of the entire national income. "Now," says the economist, "on the face of it, that cannot last; it is impossible that a state of affairs like that should persist," and he then proceeds to ask the question how soon the Country will get over what I have flippantly called "its automobile jag." In other words, how long it will be before it is desaturated. He arrives at the conclusion that in 1927, if you examine the population of the United States, you will find that it is desaturated of automobiles.

The case with motor trucks is a little better. The economist thinks that we shall be desaturated of them in 1924. But we have 5 long, weary years ahead of us, with a headache and all the unpleasant consequences of being over-saturated with automobiles.

Who Must Have Automobiles?

I will not try to analyze the economist's economics. That would occupy the whole evening. I shall simply remark in connection with what he has said that his premise that nobody in the United States who has not an income of $2,000 or more is entitled to have an automobile, is one that to a person like myself of farming antecedents is a little curious. I should say from what I know of the farming situation that there are at least 9,000,000 people in the United States who cannot afford not to have automobiles. In other words, we have, it seems to me, if I may venture to differ from my fellow economist, the situation in this Country, and it is not confined to this Country, it is world-wide, of millions upon millions of people who cannot afford not to have an automobile, no matter what their income is.

Of course, this is an old story. I remember that when I was a youngster the same thing used to be said about

[1] Editor, *Economic World*, New York City.

horses. Nobody could afford to have a horse unless he had such and such an income. Well unfortunately, a farmer, to take him alone, had to have a horse, no matter what his income was. In many cases the horse had a better income than the farmer had. But the farmer had to have the horse.

What has happened, only too evidently, it seems to me, if one examines the agricultural population of the world, is that there alone, quite without regard to the monetary terms of income, there are, as I said a moment ago, millions upon millions of people who as a matter of plain, economic necessity have to have an automobile.

Joy-Riding Over

There is, however, it seems to me, one rather interesting deduction to be made from what I regard as the gross error of my fellow-economist. It is a deduction which has already been intimated by your Toastmaster and by your President. The deduction is that the automotive industry has now come to a point at which the economic uses of automobile vehicles, of one kind and another, are of predominant importance. If I may put it briefly, I should say that the joy-riding days of the automobile are pretty nearly past, and perhaps I might add that the joy-riding days of the automotive industry are pretty well past. I think you will admit that the amount of joy-riding that has gone on in the automotive industry, taken altogether, has been fully as impressive as the joy-riding of the clerks and the typesetters and all kinds of people who like to go to Coney Island and go in a hurry and think they cannot afford to go for a 5-cent fare. The automotive industry has got to the point, then, at which economic considerations must be the predominant and determining considerations. Now this has been hastened, unquestionably very greatly hastened, by the economic occurrences of the past year or year and a half. The world-wide financial and industrial depression has brought out a truth in connection with the automotive industry that probably would not have been brought out for some time if we had continued in that exaggerated and artificial prosperity that we enjoyed, or thought we enjoyed, in 1919 and the first months of 1920.

The Engineer

That truth having been brought out, if you will permit me to say so, I believe you will find that the part of the automotive engineer will become from now on enormously greater than it has been in the past. In the past the automotive engineer has been a useful agent. He has been looked to as the man who provided the wherewithal for the joy-riding. From now on you will have a different situation, but that situation will not be an easy one. Unless I am mistaken, a stage has been reached in the automotive industry that is very much like the stage that was reached by the railroads 25 years ago, a stage in which the railroads kept themselves alive by what their engineers did for them, in which the railroads, subjected to, as it seems to me, very intolerable regulations of the Government in the matter of rates, had to do engineering marvels if they were to keep the breath of life in them.

The engineers have done that for the railroads in the past 25 years. Those of us who have had occasion to follow the accomplishments of the engineers in connection with the railroads are constantly amazed at what they have done. The sad thing about it is that the railroads have not got anything out of it at all as yet. Financially speaking, they are today in a worse condition than they were 25 years ago, in spite of all the engineers have done for them. All that can be said is that the engineers have saved them from utter ruin. I myself believe that the corner has been turned by the railroads and that they have a better day ahead of them, but it has been a desperate struggle and mainly a struggle of engineers.

Part-Capacity Production

You have ahead of you in the automotive industry something not unlike what the engineers have had in the railroad industry. You will have to work your very hearts out in the next 5 years, just to keep yourselves alive, because they will be hard years. I was impressed, in looking over statistics issued recently, by the fact that your production during 1921 was between 1,600,000 and 1,700,000 passenger cars and trucks, but that that production was 24 per cent less than the production of 1920. In other words, it was certainly 24 per cent less than your capacity.

Every economist knows that the bitterest times through which an industry passes are the times when production is from 70 to 90 per cent of capacity. Those are the times when competition is the most bitter, when prices irresistibly crowd down upon every establishment in the industry. It is more difficult to make any money in an industry when it is operating at 80 per cent of capacity than at any other time. When the operations of an industry are only 30 or 40 per cent of capacity, there is not much price-cutting; it is not worthwhile; it is evident to everybody that it is not worthwhile. But let the demand get up to 80 per cent and then every manager and director in that industry immediately begins to say to himself, "There is a lot of business passing, a lot of it; now if I can only get enough of it to fill my establishment, I shall get my overhead down and then I can begin to make money." The overhead, what I may call the doctrine of overhead, as an accounting proposition is like acid eating away prices when an industry is operating at 75 or 80 per cent of capacity.

So when I saw that during the past year the output of the automotive industry in this Country had been 24 per cent less than capacity, I should have known, without looking at a single advertisement, that there had been price-cutting in every direction in the industry. It always happens under such circumstances.

That is the kind of pressure you engineers will have on you. You will have the competition that arises in its greatest intensity when an enormous product is demanded but not enough product to fill all the establishments to capacity. It will be for you to work out the means by which you can meet this situation, the means by which you can gradually bring the automobile vehicle, whether a passenger vehicle or a commercial vehicle, into such nice adjustment with the economic needs of the communities of this and other countries that once more there will be a free flow of automobile vehicles to consumers; once more your capacity will be fully occupied and then once more you will begin to make a reasonable and comfortable profit.

But do not think for a moment that as a matter of economics you will not have a hard time of it, because you will. When I say this I know, of course, that I am talking to gentlemen who respond in their own mind to a demand of this sort. It is one of the honors of the engineering profession of the United States that it has perpetually done the impossible. There is no great profession in the United States of which it can so consistently be said that over and over and over again it has done the impossible, as the engineering profession, and I am sure that automotive engineers differ in no respect

from the great body of engineers of which this Country has such great reason to be proud.

But after all, I am not talking about my subject, "How We Are to Know When Business Has Turned the Corner."

I will give you only two or three rather simple tests that you yourselves can apply, if you follow the course of business, and by which you can arrive at a reasonably fair conclusion as to the moment from which there will be a steady onward, upward movement of all kinds of business.

Goods Bought Only With Goods

The first of these tests you will not find laid down in the economic textbooks, but it is an economic principle none the less; that in the long run, in the last resort, the only way in which goods can be bought is by goods. Goods are bought with goods and with nothing else. We all think of buying goods with money because we go through the form of paying cash or drawing a check; but, fundamentally, money is nothing; neither actual money nor that artificial money which we call bank credit. You can go on, I grant you, for a little while buying goods with actual money or with created money, banking credit, but you cannot go very long; you can gc for a year, perhaps for 2 years, but in the end you come back to the old inevitable truth that the only thing that will buy goods is goods.

Now the troubles of the world at the present time are generally painted to us by our bankers, who are chiefly heard as exponents of our situation, as due to demoralization of credit, of banking, of the currencies, of exchange, particularly the banking, the credit currency and the exchange of the countries of Europe. Our bankers tell us that if we, here in the United States, will only subscribe money enough to give Europe unlimited credit, Europe will buy our goods in unlimited quantity; our industrial activity and prosperity will immediately return and everybody will be happy. I regret to say that I think that that is one of the most pernicious doctrines of the present time. It is not by money or by credit that Europe can buy our goods or that we ought to sell our goods to Europe. Europe must buy our goods with goods; that is the only way she can buy them for long.

Buying by Germany

It is an interesting fact to one who bears that principle in mind that wherever you find in Europe people at work and producing goods, you find them buying goods, notwithstanding the condition of their credit, the condition of their currency or the state of their international exchange. The best illustration I know of this is the country that was our arch-enemy in war, Germany. Apparently, there is something about getting a licking that makes people ready to go to work; the Germans got a licking and they have gone to work.

Down in the gambling institution of which I am a member we hear every little rumor of coming financial trouble. One of the things that we heard much about for very many months is the awful depreciation of the German mark. The persistent depreciation of it we have heard of day-in and day-out as a reason why things were going to the bad very rapidly; and in particular the cotton business would suffer greatly and, most important of all, the price of cotton would decline.

Now it was a very curious fact that at the very time when the German mark was at its lowest and most demoralized, Germany was the freest buyer of cotton in the United States, of all countries in the world. I remember that on the day the German mark fell to its lowest price a friend of mine who is a large exporter of cotton said, "I do not know what to think of this thing. The mark has gone to pieces and nobody wants it and they all say it is going to nothing, but I have just made the best sale of cotton to Germany, on a better basis, that I have made this year to anybody."

I said, "How are you to be paid for it?"

"Paid for it? Check on a bank in New York; nothing could be better than that, could it?"

And it is a fact that has come home to us in the cotton business that Germany, with no credit, with a currency completely worthless, you might almost say, with exchange down to a perfectly ridiculous price, with all these handicaps, has been the largest buyer of cotton in the United States this year. That is not all; she has been the largest buyer of copper in the United States this year and she has been the largest buyer of wool in London this year and she has been the largest buyer of tin in London this year. I could name a dozen commodities of which she has been the largest buyer in the world, if we except the United States. And, mark you, Germany has not any money and she has not any credit. I say she has no money; you cannot call German marks money now. But she comes over here and she wants $1,000,000 worth of cotton and goes to a Cotton Exchange member and buys $1,000,000 worth of cotton and pulls $1,000,000 out of her breeches pocket, if that is a correct way of speaking. She wants copper and produces the cash and she wants these other things and produces the cash.

How does she do it? There is no question how she does it. She does it because she produces goods and because she gets those goods out into the world and because with those goods she can buy goods.

Idle Working People

Our English friends are feeling very much disturbed at the present time. As you know, they are talking about the necessity of a financial rehabilitation of the Continent of Europe. They tell us that there must be organized an enormous institution that will put the finances and the credit and the exchange of Europe upon a safe and sound basis, and Lloyd George has been as busy as he could be in the last week down at the Inter-Allied Conference at Cannes, working out a scheme, back of which, I may mention, stands the United States of America, with its assumed illimitable wealth, ready to put up the cash. With this institution Europe will once more be able to be a great market and in particular will buy the products of British industry and things will be very comfortable and very nice.

Then those of us who study the dry statistics of foreign trade all over the world come upon some curious facts. We find, in the first place, that these demoralized countries in Europe have been buying of Great Britain a larger proportion of British exports than they bought in 1912 and 1913, and that the United States of America, about whose credit I suppose nobody seriously doubts, has been buying less of British products than it bought in 1912 and 1913. On the face of those figures it would seem as though a rather expedient thing to do would be to get the United States buying. Perhaps the idea of the Cannes conference is to get *our* credit stiffened up so that we can buy.

The hitch is here: Lloyd George and many of the statesmen and financiers of England taught the working people of England, and I include among the working people of England not only the wage earners but also the managers of industry and the producers of England, that after the war they would work less and get more than

they did before the war. Consequently the British coal-miners are insisting that they shall work only 30 hr. a week and be paid four times as much as they were paid before the war for 54 hr. a week.

You find the same thing in the British iron and steel and cotton industries. When you study the statistics of British production and foreign trade, you find that at no time since the war has production in Great Britain been as much as 60 per cent of what it was in 1913, in spite of the fact that there are in England, according to their own official statements, more workers than there were in 1913, because there has been no emigration from Great Britain during or since the war.

British Ferrous-Metal Production

Then you come upon a marvelous condition of affairs. We will take the great iron and steel industry that, next to the cotton industry, is the greatest of the export industries of Great Britain. The normal production of pig iron in Great Britain is 750,000 tons a month. The normal production of crude steel, steel ingots and castings in Great Britain is 875,000 tons a month. What do you suppose the production of pig iron and crude steel was in June, 1921? Unless you know the figures, you cannot have the faintest idea of what they were. In pig iron, where there should have been a production of 750,000 tons a month, there was a production of 1500 tons. In crude steel, where there should have been a production of 875,000 tons a month, there was a production of 800 tons. Now just imagine the British industries, the engineering industry, the cutlery industry, the railroad equipment industry, the thousand and one industries that are dependent upon iron and steel as the raw material that they are to turn into products to send to the outer world wherewith to buy products, and think what it means to have the production of pig iron come down to 1500 tons in a month and the production of crude steel to 800 tons a month!

There is where the hitch is. That is why we are having trouble in selling our goods as freely as we should like abroad. They are not working; they are not producing; they are not making the goods that can be paid for goods; and we cannot sell goods unless other people make goods with which to pay for our goods.

You can talk about banking credit, you can talk about the restoration of the exchanges, you can talk about all those things that our financiers tell us about until you are black and blue in the face, and you will not improve the situation one iota unless people go to work and produce goods wherewith to buy goods.

Conditions in This Country

Gentlemen, I have been using as an example Great Britain, which I love and in which I believe with all my heart and soul. But I am sure that no one of you sitting here fails to realize that we have substantially the same situation right here in the United States. We have millions of men still who do not wish to produce goods upon terms that the world can meet, and because they cannot produce goods on the terms they want, they do not produce them at all, and because they do not produce them at all, every industry suffers. If those goods were produced, the products of other industries would be bought and paid for.

Sometimes a gambling economist like myself wonders at the things men say and do. We have here in the United States a large amount of industrial unemployment. We have had a Conference at Washington to discuss what should be done about it. We have considerable agitation in our States and in our cities, and our newspapers talk about it; we talk about public works and this, that and the other expedient to get rid of industrial unemployment. Yet at the very same time that we are doing this we are saying to the farmer in Iowa or Nebraska, "In 1913 when you wanted to buy a farm wagon we were glad to sell it to you for 200 bushels of corn; today we expect you to pay 750 bushels of corn for the same wagon." To the farmer in Kansas or Texas we say, "In 1913 we were glad to sell you a pair of shoes for a cowhide; today we expect you to give five cowhides for a pair of shoes." To the dairy farmer up in Michigan we say, in similar fashion, "In 1913 for four calfskins you could get as good a pair of shoes as anybody needed; today we expect you to pay 21 calfskins for a pair of shoes."

To come a little nearer home, we say to the farmer in Nebraska, Iowa, Illinois, "In 1913 we were glad to sell you an automobile that was pretty well adapted to your purposes for 1500 bushels of corn; we now expect you to pay 4000 bushels of corn for the same automobile."

The farmer says, "I cannot and I will not do it. There is no use talking to me about doing it; I will not do it and I cannot do it."

A friend of mine came back the other day from a trip out through Nebraska and surrounding territory. He said, "Heavens and earth, the clothes those farmers out there are wearing look like Joseph's coat of many colors." We said to them in 1913, "For 100 bushels of corn we will sell you a very good suit of clothes made in New York." Now we say, "We expect you to pay 500 bushels of corn for the same suit of clothes because our industrial workers in New York who make clothing insist that they must be paid 255 per cent more than they were paid in 1913."

The farmer says, "I get only 60 per cent of what I got in 1913. How can I, getting 60 per cent of what I got in 1913, give to a clothing maker in New York City 255 per cent more than he got in 1913? I cannot and I will not."

The farmer is coming in for a large amount of condemnation these days because he has what is called a bloc down in Washington, supposed to be working in his interests. We are told that that is class legislation and contrary to the spirit of our institutions, and I rather think it is; but that is not the essential point. The essential point is that when our shoemakers are ready to sell shoes to the farmer for the same number of bushels of corn as in 1913, the farmer will buy just as many shoes as he ever bought; when our clothing makers are willing to sell clothing to the farmer for the same number of bushels of wheat as in 1913, the farmer will buy just as many suits of clothes as ever he bought; when our agricultural implement makers will sell a farm wagon or a plow or a tractor to the farmer for the same number of bushels of wheat or of corn or pounds of beef or pork as in 1913, the farmer will buy just as many wagons and plows and tractors as he bought in 1913; but he will not buy them until that comes about. The same thing applies to your industry as to these that I have mentioned.

Return of Economic Balance Necessary

The clearest-headed economic thinker in the United States is, to my mind, George E. Roberts, vice-president of the National City Bank, who addressed you a year ago. Mr. Roberts has been calling attention for many months to the fact that there is a natural equilibrium or balance between the various producing and consuming classes in each country and between the producing and

consuming countries of the world, and that the real root of our economic troubles at the present time is that that equilibrium, that balance between the producing and the consuming classes, has been turned topsy-turvy by what has happened during and since the war; and that turning the corner means getting back to that state of balance or equilibrium which, from an economic standpoint, has resulted from three generations of gradual adjustments under the stress of competition.

Within reasonable limits, when the farmer in 1912 and 1913 exchanged wheat for shoes, for clothing, for an automobile, he made the exchange on a basis that represented approximately the same amount of labor, effort, capital employed, and the like, that was represented by the product that he bought. Today that is all upset and the first and most important test of a business entering upon a real, continuous and dependable course of activity and prosperity is a return to that equitable balance or equilibrium of which I have spoken.

One could wish that when this fundamental truth is so clear as it is to minds like Mr. Roberts' that the process might be worked out by the wit of man. You engineers, in particular, accustomed to problems that you sit down and tackle and work out by your brains, must say to yourselves 100 times, "Why in the name of heaven cannot we take this great problem and work it out with brains in the same way that we work out our problems?" Why it cannot be, no one can tell. Human nature is so curiously constituted, particularly mass human nature, that apparently a rational process of working out these problems is impossible; but do not think for that reason that they are not working themselves out, because they are. They are working themselves out by a process of grinding that produces suffering in every direction, but none the less they are working themselves out.

Urban and Rural Incomes

I have indicated in a general way one of the great inequalities existing at the present time by what I have said of the farmer and what he buys. That can be generalized, however, still more broadly and I may say that one of our great economic problems is the lack of equilibrium, economically speaking, between the agricultural population as a whole and the urban population. How many of you really understand how extraordinarily great that lack of equilibrium is? You know that the population of the United States is almost equally divided between urban dwellers and rural dwellers, urban industrial producers and agricultural producers, but do you know that according to the best information we can get, information that has been brought together recently in a wonderfully instructive book gotten up by a new society for economic research here in New York City, with the population of this Country equally divided, the national income was divided for the 10 years ended with 1918 in the proportion of 17 per cent to the agricultural population and 83 per cent to the urban population? The urban population got more than four times, nearly five times, the income that the rural population got, and yet the numbers of the two populations were identical.

That, gentlemen, is a state which is inequitable and cannot endure. The truth is that during the war period and since the war period our urban population, to use a slang phrase of my gambling institution, has been getting away with murder, but it is having a hard time now.

To illustrate how the thing is changing, I will simply take 1 lb. of cotton and tell you what was happening with it in 1919 and the beginning of 1920 and what is happening to it now. In the end of 1919 and the beginning of 1920 a cotton farmer in the South sold his pound of cotton for approximately 40 cents, which was regarded as an inordinately high price. That pound of cotton left the farmer's hands and immediately came into the hands of industrial and urban workers, managers, financiers and all the rest of us who live in cities.

First, the cotton was sent to a mill, we will say in Fall River, that manufactures what we know as grey goods, semi-finished cotton fabric, and the manufacturer in Fall River took that pound of cotton and turned it into grey goods, getting 6 yd. of grey goods out of the pound. Those 6 yd. the manufacturer sold to what we call a converter, an establishment that bleaches, dyes, prints and treats the cotton fabric to make coat-linings or curtains or a thousand and one things that you buy at a retail store.

The cotton manufacturer in Fall River sold the pound of cotton in the form of 6 yd. of cloth to a converter for 22½ cents per yd., getting $1.35 for the pound of cotton in the form in which he was through with it. The converter, in his turn, after having bleached, dyed, printed and finished the cloth, sold the goods to a jobber for approximately $1.75 for the 6 yd.

Then the jobber, in his turn, sold the goods to a retailer, one of our department stores we will say, and the jobber got about $2.25 for the 6 yd. Then the goods were in the hands of the retailer. Well, you know what the retailer did! He sold the 6 yd. of cotton cloth for about $4. I am giving you roughly the prices that we had all along the line in 1919 and the beginning of 1920.

In other words, between the farmer's 40 cents and the ultimate price of the cotton cloth made out of the pound of cotton, there was the difference between 40 cents and $4, or $3.60, and that $3.60 all went to urban and industrial workers. The railroad workers got the first hack at it; then it got to Galveston or Atlanta or Savannah, to a port, and the stevedores got a hack at it; the truckmen got a hack at it; the people that handled it in and out of the ship got a hack at it; then the steamship company; then it got here to New York City and the lightermen took another hack at it. The merchants all along the line were taking nice pieces out of it, and it went to the manufacturer in Fall River. The wages of the manufacturer's help had been raised 148 per cent; they took a good piece out of it. When the manufacturer was through with it, it went to the converter; his help had been raised about 180 per cent; they got a nice piece. And so, all along the line from the farmer's 40 cents to the $4 ultimately realized, one set after another were taking a fine bunch of picking out of this pound of cotton.

What is the situation today? The farmer in the South gets, we will say roughly, 20 cents per lb. for his cotton. It goes to the manufacturer in Fall River; he makes it into 6 yd. of cloth but, instead of being able to get 22½ cents per yd., the best he can do today is 6½ cents per yd.; instead of getting $1.35 for the pound of cotton, he gets about 39 cents. Then it goes to the converter and he, instead of being able to get $1.75, is able to get only about 60 cents. It goes from the converter to the jobber and he, instead of being able to get the price I mentioned, $2.25, is able to get only about 75 cents. It then goes to the retailer and the retailer, you will see if you will look at the advertisements in the papers, is no longer getting $4 for 6 yd. of cloth; he thinks he is doing very well if he gets $1.25.

The point I am coming to is that whereas in 1919 $3.60 was divided up along the line to urban and indus-

(*Concluded on page 110*)

Officers of the Society

AT the Annual Meeting of the Society held last month a President; a First Vice-President; five Second Vice-Presidents; and four Councilors, three of whom were elected for the full term of 2 years and one to serve for 1 year only, were elected; and the Treasurer was reelected. In addition to these officers, two of the three Councilors elected at the 1921 Annual Meeting and the last Past-President are voting members of the Council for 1922. Photographs of the men who will guide the work of the Society this year are presented on the following pages and their careers are outlined below.

B. B. Bachman

President Bachman was born Oct. 4, 1886, educated at grammar school, night school and under a private tutor, and started his business experience in 1900 as a tracer. The next 10 years were spent as tracer, detailer and designer with the Enterprise Mfg. Co., and the Falkenay Sinclair Machine Tool Co., both of Philadelphia, and the Autocar Co., Ardmore, Pa. His entire automobile experience has been with the last-named company, which was a builder of passenger vehicles until 1912 and has constructed commercial vehicles from 1907 to date. Starting with this company in February 1905, he became assistant engineer in 1909 and engineer in 1914.

Mr. Bachman was elected a Junior member of the Society in 1910 and transferred to Member grade in 1912. He is a member of the American Society of Mechanical Engineers, American Society for Testing Materials and the Institution of Automobile Engineers. When the Pennsylvania Section was organized he was one of the charter members and served as its first secretary. He was identified with the work of the Truck Standards Division in 1911 and has been Chairman of the Standards Committee since 1918. At present he is a representative of the Society on the American Engineering Standards Committee. He was elected to the Council in 1916 and again in 1918. In 1919 he was First Vice-President of the Society, and in 1921 Second Vice-President representing motor-car engineering. As a member of the Truck Standards Division Mr. Bachman participated in the formulation of the specifications for military trucks for the Quartermaster Department, and afterwards was engaged at irregular intervals in the design of Class B and Class A military trucks. In connection with the last named, he was chairman of the committee on design.

At the 1913 Annual Meeting Mr. Bachman presented a paper entitled Comparative Results with Solid and Pneumatic Tires on Light Commercial Vehicles, and at the 1914 Annual Meeting he treated the subject of Double-Reduction Live Axle. At the 1919 Motor Truck Meeting he gave an address on Pneumatic Tires for Trucks.

J. V. Whitbeck

First Vice-President Whitbeck was born May 28, 1882, at Sodus, N. Y. He was employed as a draftsman and designer by the H. H. Franklin Mfg. Co. from September 1904 to October 1906, when he entered the service of the Olds Motor Works as a designer. Leaving there in March 1907, he accepted a similar position with E. R. Thomas, Buffalo. In October of that year he was engaged as designer and checker by the United Spring Co., Buffalo. In 1908 he became designer, checker and experimental engineer with the Lozier Motor Car Co. Mr. Whitbeck was chief engineer of the Chandler Motor Car Co. from 1913 to February 1921, when he was elected president of the Cleveland Automobile Co., the position that he now holds.

Mr. Whitbeck was elected to Member grade in the Society on Oct. 18, 1912, and was elected a Councilor at the 1919 Annual Meeting.

F. E. Watts

Second Vice-President Watts, representing motor-car engineering, was born May 22, 1879, on a farm at West Falmouth, Me. He received his education in the common schools of Falmouth Township, and prepared for college at Greely Institute, Cumberland Centre. He attended the University of Maine and was graduated in 1901 with the degree of Bachelor of Science in Electrical Engineering.

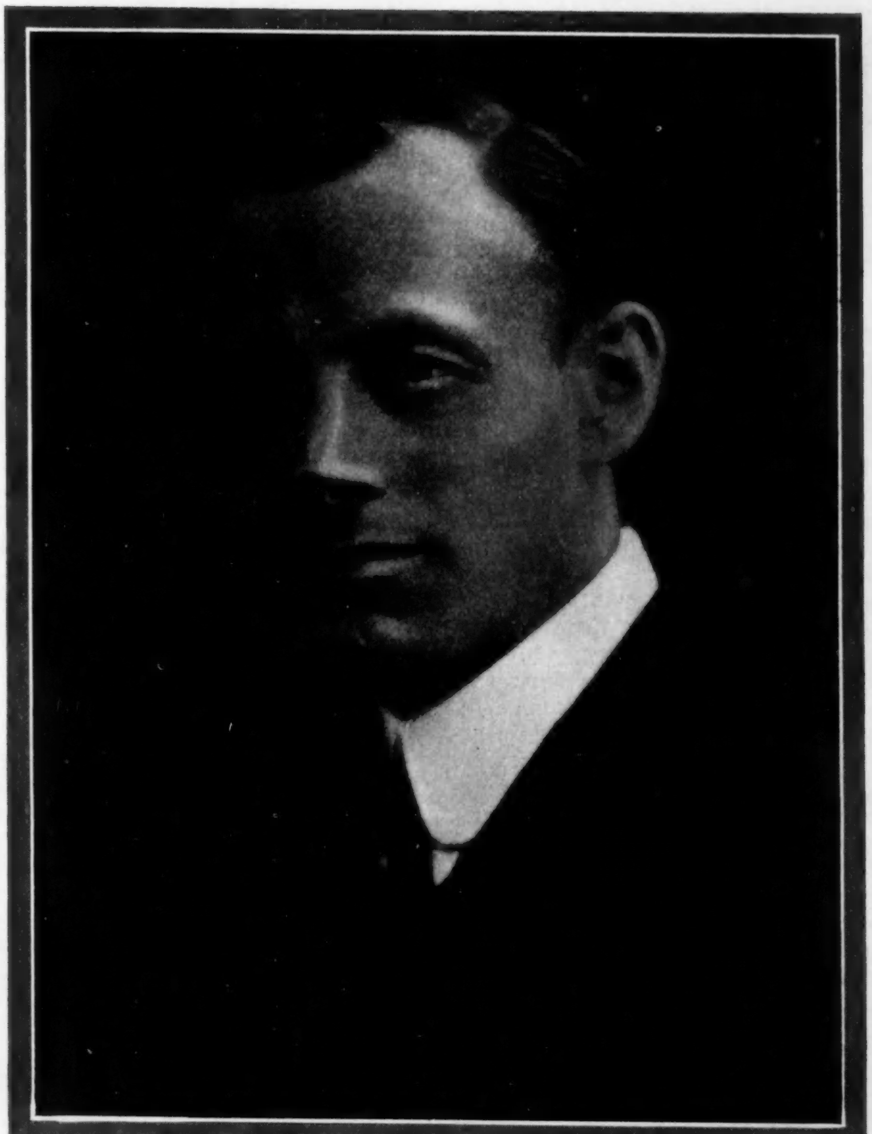
His first position was that of tracer and draftsman for the Holley Motor Co., of Bradford, Pa., where he worked on motorcycles, air and water-cooled engines, light cars and carbureters. After remaining there for 6 months he left to enter the service of the Taylor Signal Co., Buffalo, as a draftsman on electrically operated railroad signals. In 1902 he secured his first position as a designer with the J. W. Ruger Co., also of Buffalo, builder of gas and gasoline engines and baking and candy machinery. After remaining there 15 months, Mr. Watts made his entrance into the automobile field by securing a position in the drafting-room of the Electric Vehicle Co., Hartford, Conn., where he remained for 2 years. In 1905 he became associated with the Eisenhuth Horseless Vehicle Co., Middletown, Conn., where he held the position of designer of automobiles and compound engines for 1 year, when he returned to the Electric Vehicle Co. In 1906 he severed connection with that company and went to Detroit as traveling representative and technical writer for the *Horseless Age*. At the same time Mr. Watts was engaged in consulting work on automobile design and did considerable research on air-cooled two-cycle engines. The year 1909 was devoted to the development of a rotary-valve engine and an automobile. In 1910 he entered the service of the Hupp Motor Car Corporation, as designing engineer, subsequently becoming chief engineer of that company, which position he still holds.

Mr. Watts became a Member of the Society in the spring of 1908.

O. W. Young

Second Vice-President Young, representing tractor engineering, was born at Chicago, in 1885. He attended the public schools and the technical high-school of his birthplace and studied for 1 year in preparation for the practice of mechanical engineering.

In 1905 he became a draftsman with the Western Electric Co., at Chicago, and was subsequently transferred to the engineering department. Mr. Young spent a year designing steam specialties and from September 1908 to June 1910 was associated with the Chicago Engineering Co., on development work. Relinquishing that connection he became associated with the Economy Motor Car Co., Joliet, Ill., as a mechanical engineer, this marking his entry into the automotive field. While associated with this company he designed a motor truck and also de-



B. B. BACHMAN

signed and built a light electric town-car. In November 1912 he accepted a position as engineer with the Minneapolis Motor Co., Minneapolis, manufacturer of motorcycles and light package-delivery cars, resigning in December of the following year to enter the service of the H. E. Wilcox Motor Co., also of Minneapolis. In August 1914 Mr. Young became associated with the McVicker Engineering Co., a consulting engineering organization, of Minneapolis, in the design and development of several light tractors. In March 1915 he entered the service of the Hyatt Roller Bearing Co., Chicago, in its tractor bearings division and has been associated with that company ever since. At present Mr. Young is engineering manager of the tractor bearings division.

He was elected to Member grade in the Society April 17, 1917.

V. E. Clark

Second Vice-President Clark, representing aeronautic engineering, was born at Uniontown, Pa., Feb. 27, 1886. He was educated at the Uniontown public schools and was graduated from the United States Naval Academy at Annapolis, Md., in 1907. When the battleship fleet of the Navy made its famous world cruise in 1907, 1908 and 1909, Ensign Clark was attached to the fleet, and in 1909 made another cruise to China and the Philippines. He was commissioned second lieutenant in the Coast Artillery Corps in 1910 and served at Boston, San Francisco and Honolulu for 2 years.

Lieutenant Clark became interested in aeronautics in the early part of 1912, when he took up the study of airplane design and in April 1913 he was transferred at his own request to the newly organized aviation section of the Signal Corps. He holds a pilot's license dated Nov. 4, 1913, which is one of the earliest granted in this Country. In September 1914 Captain Clark was ordered to the Massachusetts Institute of Technology to take a post-graduate course in aeronautical engineering, and was the first officer graduated from this course. Upon the completion of the course in 1915 he was immediately placed in charge of the San Diego, Cal., experimental and repair depot. In March 1916 he was transferred to the City of Washington as chief aviation aid to General Squier with the title of chief aeronautical engineer of the United States Army. Captain Clark was appointed a member of the National Advisory Committee for Aeronautics in 1916 and when the United States entered the world war he was the aeronautical member selected by the Aircraft Production Board to serve on the Bolling Mission that visited France, England and Italy.

He was commissioned a lieutenant-colonel on Aug. 5, 1917, and undertook the organization of the Army experimental air-station at McCook Field, Dayton, Ohio, where he was responsible for a large portion of the aircraft engineering design work, including the first all-American battleplanes. In March 1918 Colonel Clark was recalled to the City of Washington and during the summer of that year was in command of the air-service concentration camp and general supply depot at Morrison, Va. He was subsequently reassigned to the engineering division of the Air Service at McCook Field, where he remained as chief engineer in charge of airplane design until November 1920, when he left the Government service to become chief engineer of the Dayton Wright Co., a position that he now holds.

In the past year Mr. Clark carried to completion four widely different and remarkably successful original aircraft designs. These were a twin-float seaplane intended for timber cruising and aerial photographic work, a shipboard airplane for the control of gun-fire in naval engagements, a side-by-side training airplane for the Army Air Service and an airdrome-defense airplane.

Mr. Clark was elected to Member grade in the Society, Sept. 12, 1916. In conjunction with Capt. T. F. Dood and O. E. Strahlmann, Mr. Clark presented a paper entitled Some Problems in Airplane Construction at 1917 Annual Meeting In addition, he has presented three other papers before the Society: Types of Military Airplanes, at the 1918 Annual Meeting; Maintaining Airplane Engine Power at Great Altitudes, at the Aeronautic Meeting of the Society held at New York City in 1920; and Air Transportation and the Business Man, at the 1921 Semi-Annual Meeting.

C. B. Segner

Second Vice-President Segner, representing stationary internal-combustion engineering, was born at Lamar, Pa., July 29, 1871. His boyhood days were spent helping his father who operated a small planing-mill, an experience that doubtless developed his mechanical inclinations. In 1890 he became an apprentice in the bicycle factory of the Crawford Mfg. Co., Hagerstown, Md., and 2 years later was transferred to the tool-making department. While serving in the latter apprenticeship he studied mathematics and physics under a private tutor and also took a correspondence course in gas-engine design. In 1894 Mr. Segner was appointed assistant foreman in the tool-making department and 3 years later was promoted to foreman and given supervision over the designing and making of tools. Leaving the Crawford plant in 1901, when the bicycle business began to decline, he accepted the position of machine-shop foreman with the American Machine & Foundry Co., at Hanover, Pa.

In 1902, with his brother, H. H. Segner, and A. S. Dornblaser he organized the Domestic Engine Co. to build small engines for farm and domestic use. The following year Mr. Dornblaser's interest was purchased by J. E. Reisner, of Shippensburg, Pa. At that time the plant was moved from Hagerstown, Md., to Shippensburg, and the business incorporated as the Domestic Engine & Pump Co. With this change in the location of the plant the construction of farm engines was discontinued and the building of a complete line of portable direct-connected pumping and hoisting engines for contractors' use was undertaken. In 1916 Mr. Segner was promoted from superintendent to vice-president and general manager, his present position. He has either designed or supervised the designing of the engines built by this company since its organization.

He was elected to Member grade in the Society, Feb. 13, 1920.

Henry M. Crane

Councilor Crane was born on June 16, 1874. He received his education in private schools, with a final year at Phillips Exeter Academy, graduating in 1891. He was graduated from Massachusetts Institute of Technology in 1895 with the degree of Bachelor of Science in Mechanical Engineering and in 1896 with a similar degree in Electrical Engineering.

After graduating he joined the laboratory force of the American Telephone & Telegraph Co. in Boston and worked there 2 years. In 1898 he was transferred to the engineering department of the Western Electric Co. in New York City, where he worked first on the preparation of telephone switchboard installation specifications and later on the development of apparatus and circuits.

J. V. WHITBECK

F. E. WATTS

O. W. YOUNG

V. E. CLARK

C. B. SEGNER

DAVID BEECROFT

C. B. WHITTELSEY

In 1905 he left the engineering department to become engineering assistant to H. B. Thayer, general manager of the company, and finally resigned from the company in 1906.

In 1906 Mr. Crane organized the Crane & Whitman Co. in Bayonne, N. J., for the development of gasoline automotive machinery and especially motor cars. This company later became the Crane Motor Car Co., and in 1914 was consolidated with the Simplex Automobile Co. He was president of the Crane Motor Car Co. and vice-president of the Simplex Automobile Co.

In 1916 the Wright-Martin Co. was organized and absorbed the Simplex company. Mr. Crane became vice-president in charge of engineering and remained in this position after the reorganization of the company as the Wright Aeronautical Corporation, about Jan. 1, 1920. He resigned from the latter company on March 15, 1920, and for the remainder of the year was not engaged in any regular business but did some consulting work. During the past year he has been engaged in the development of a new passenger-car, the powerplant of which is now undergoing road tests in an old chassis.

Mr. Crane has taken a prominent part in the work of the Fuel Committee of the Society, and is Chairman of its Research Committee and the Aeronautic Division of the Standards Committee. At the 1920 Annual Meeting of the Society he was elected Second Vice-president representing aeronautic engineering.

W. R. Strickland

Councilor Strickland was born in 1875 at Cincinnati. He received his education at the Chicago Manual Training School and at the Massachusetts Institute of Technology from which he was graduated with the degree of S.B. in 1898. Immediately after graduation he entered the Navy as an assistant engineer with the rank of ensign and served at the Mare Island Navy Yard on the Pacific Coast and in the Hawaiian Islands on the U. S. S. Bennington during the Spanish-American War. Until September 1899 he was employed as a draftsman by the Blake Pump Co., Cambridge, Mass., and the Buckeye Engine Co., Salem, Ohio. From September 1899 to January 1901 he was a designer of electric traveling-cranes and chief engineer of the Case Mfg. Co., of Columbus, Ohio. At that time he became interested in railroad work, entering the service of the Colorado Fuel & Iron Co., Denver, Col., where he was engaged in railroad location work in connection with the opening up of coal mines and marble quarries. In 1902 he became associated with the New York Central and Hudson River Railroad on railroad location and construction, general engineering, maintenance, bridge and building work. In 1904 he was assistant secretary of J. G. White & Co., New York City, and was superintendent of construction on hydraulic and electric development at San Juan, P. R., leaving there in February 1908. In July of that year he secured the position of mechanical engineer and assistant manager of the Detroit plant of the American Radiator Co. and had charge of the operation and improvement of the continuous molding plant and machining department. In 1911 he became assistant engineer with the Peerless Motor Car Co., Cleveland, Ohio, where he was engaged in the perfecting and developing of four, six and eight-cylinder engines and truck and car chassis with bodies and fittings. He was made chief engineer of this company in 1913. He resigned this position last fall.

Mr. Strickland was elected to Member grade in the Society Jan. 5, 1912. He served as Treasurer of the Cleveland Section for the administrative year 1916-1917 and was elected Chairman of the Section the following year. Last year Mr. Strickland was Vice-Chairman of the Standards Committee, Chairman of the Ball and Roller Bearings Division of that committee, and Chairman of the Sectional Committee on Ball Bearings of the American Engineering Standards Committee.

C. F. Scott

Councilor Scott was born at New York City on May 30, 1886. He prepared for college at the Haverford School, Haverford, Pa., for 4 years and was graduated from the mechanical engineering course at Haverford College in 1908.

Following his graduation he entered the service of the Sprague Electric Works in the engineering department. After serving 1 year as a designing engineer he was appointed commercial engineer of electric motor and control applications. He has been identified with the development and application of the electric dynamometer almost from its inception in 1909. In connection with his work on dynamometers Mr. Scott specialized for 2 years in the adapting of the electric dynamometer to testing automobile engines by a thorough study of the internal-combustion engine. He developed and installed the first electric dynamometer for testing a complete automobile chassis.

Mr. Scott was elected to Junior grade in the Society, Oct. 24, 1911, and was transferred to Member grade, Sept. 11, 1912. He was elected Chairman of the Metropolitan Section in 1918 and automatically became vice-chairman the following year in accordance with the provisions of the Section constitution. He was a member of the Society Nominating Committee, representing the Metropolitan Section, in 1918 and 1919, and was secretary of the committee in the latter year, and a member at large of the 1920 committee. He has been a member of the Meetings Committee of the Society since 1919 and during the past year served as its chairman.

Lon R. Smith

Councilor Smith was born at Brownsburg, Ind., Dec. 24, 1876. After being graduated from high school, he spent 4 years at pattern-making and 3 more at die-sinking. Since entering the service of the Motsinger Device Mfg. Co., Pendleton, Ind., as superintendent in 1903, Mr. Smith's experience has been confined to the development of ignition, carburetion and engines. In 1907 he became superintendent of the magneto factory of the Henricks Novelty Co., Indianapolis, and from 1908 to 1910 was a salesman for that organization.

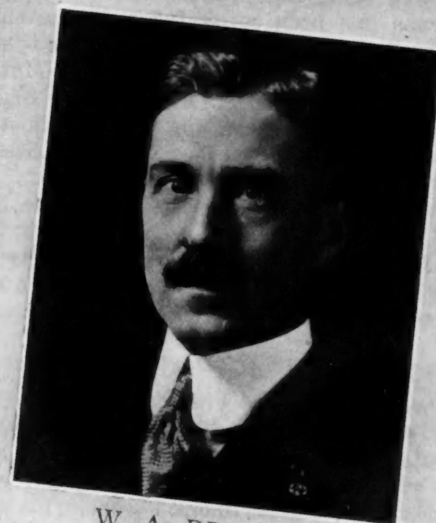
In March 1910 he was appointed Western representative of the Eisemann Magneto Co. and as such represented it in all of the United States west of Buffalo with the exception of Michigan and Wisconsin until the fall of 1916. At that time he became sales manager of the engine department of the Buda Co., Harvey, Ill. He left that company in June 1919 to accept the position of vice-president, directing sales and advertising, with the Midwest Engine Co., Indianapolis.

Mr. Smith was elected to Member grade in the Society in June 12, 1911, and was Chairman of the Indiana Section in 1915 and 1916, and was reelected chairman in the spring of 1921. He was elected Treasurer of the Mid-West Section in 1918.

W. A. Brush

Councilor Brush was born at Detroit, Nov. 9, 1872. He was educated in the high school of his birthplace

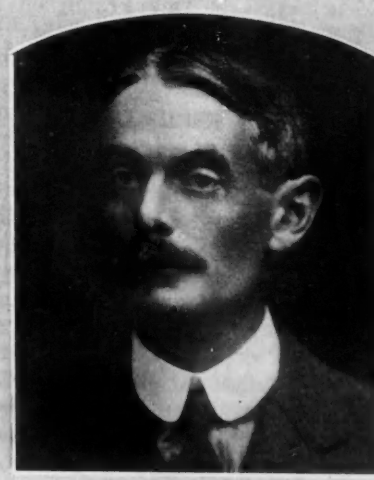
F. W. DAVIS



W. A. BRUSH

C. F. SCOTT

LON R. SMITH



H. M. CRANE

COKER F. CLARKSON

W. R. STRICKLAND

and also pursued some independent courses of instruction. Mr. Brush has been connected with the sales department of the Packard Motor Car Co., and was formerly head of the technical department of the Buick Motor Co., Flint, Mich. Together with A. P. Brush he organized the Brush Engineering Association at Detroit, to give technical advice to motor-car builders. He has been business manager of that organization since 1913.

Mr. Brush was elected to Membership in the Society January 1914, and has taken a prominent part in the affairs of the Detroit Section, having served as its Chairman. He has also rendered the Society valuable service as Chairman of its Membership Committee.

Francis W. Davis

Councilor Davis was born at Philadelphia in 1887. His first business venture was at the age of 17, when he managed a motorcycle agency and had charge of a small machine-shop which specialized in repairing automobiles and motorcycles and in experimental work. From 1906 to 1910 he attended Harvard University and studied mechanical engineering with particular reference to steam and oil engines. He was graduated in 1910 with the degree of Bachelor of Science.

Upon leaving college he entered the service of the Pierce-Arrow Motor Car Co., Buffalo, and took a course in the various departments of the factory. He was then placed in the experimental department and afterward transferred to the sales department as a sales engineer. In 1915 and 1916 Mr. Davis was consulting engineer on motor trucks for the British Admiralty and War Office. In this position he had to do with the selection of the equipment, its inspection, the training of the personnel, the establishment of repair and maintenance facilities and the operation of the equipment overseas. He returned to the Pierce-Arrow Motor Car Co. in 1916 as assistant chief engineer of the truck department and since that time has been truck engineer and consulting engineer of the truck department, in charge of design, experimental work, testing and quality, his present position.

Mr. Davis was elected a Member of the Society in 1916. He is a member of the Truck Division of the Standards Committee, the Truck Standards Committee of the National Automobile Chamber of Commerce, the Permanent Committee of Washington Highway Transportation Conference, and served as Chairman of the Society's Committee on the Science of Truck Operation.

Charles B. Whittelsey

Treasurer Whittelsey has been connected with the Hartford Rubber Works Co. since 1901, beginning as its purchasing agent. In 1905 he was made assistant to the general manager, in 1906 superintendent, in 1911 secretary and factory manager, in 1915 vice-president and factory manager, and in 1916 president and factory manager. He has served as president of the Hartford Chamber of Commerce and of the Hartford County Manufacturers' Association.

Mr. Whittelsey was elected to Membership in the Society in 1910. In 1916 he was elected a Life Member. He was a member of the Standards Committee for several years, beginning in 1911, and served as chairman of the Tire and Rim Division in 1918 and 1919. Mr. Whittelsey was a member of the Council in 1912 and 1913, and was elected Treasurer in 1918 and reelected each year since. At the 1912 Annual Meeting he delivered a paper on Solid Motor Tires, and at the 1915 Annual Meeting presented a paper entitled The Pros and Cons of Tire Inflation.

David Beecroft

Past-President Beecroft was born in 1875 at Marnock, Ont., Canada. He graduated from the Barrie Collegiate Institute. Beginning in 1895, he was an instructor for 6 years at a St. Thomas, Ont., school, being connected also with the editorial department of the *St. Thomas Daily Times*. Leaving St. Thomas in the summer of 1901, he was engaged by the *Chicago Daily News* as an advertising solicitor.

In 1902 he became editor of the *Automobile Review*, a weekly publication. In 1904 Mr. Beecroft was assistant editor of *Motor Age*, of which he became editor in 1907. In July 1911 he undertook, in addition to the *Motor Age* work, the position of editor of *The Automobile*. In November of that year he became also editor of *Commercial Vehicle*, and in February 1914 he took a similar position with *Motor World*. At the present time he is directing editor of the Class Journal Co., New York City.

Mr. Beecroft has been a pioneer in automobile contest work, having drafted the first stock-car racing rules and been closely identified with the American Automobile Association Contest Board for many years.

Mr. Beecroft became a Member of the Society in 1911 and has served on the Council for 5 years. He has been a member of the Meetings Committee for 6 years and its Chairman for 5 years.

Coker F. Clarkson

Secretary and General Manager Clarkson was born at Des Moines, Iowa, in 1870, and was graduated from Phillips Exeter Academy in 1888. In 1889 he was in Government service in the Post Office Department. He was graduated from Harvard College in 1894, pursuing post-graduate work there for the next 2 years. He was next engaged in connection with the installation of an underground telephone system in Philadelphia for 2 years, after which time he moved to New York City and spent several years in work on technical, legal, patent, laboratory and automobile subjects. From 1905 to 1910 he was connected with the Association of Licensed Automobile Manufacturers, as secretary of its Mechanical Branch, publicity manager and assistant general manager. During this time he was the editor of the A.L.A.M. Mechanical Branch Bulletins and of the A.L.A.M. weekly digest of current technical literature.

Mr. Clarkson has been Secretary and General Manager of the Society of Automobile Engineers and of the Society of Automotive Engineers since 1910.

During the war Mr. Clarkson was associated with the Council of National Defense, and served as a member of the automotive products section of the War Industries Board and of the International Aircraft Standards Board.

SPECIAL NOTICE

New Policy with regard to distribution of the

Transactions

and the

Membership Roster

FOR some time past there has been considerable discussion among members and the officers and councilors on the question of eliminating the more or less unnecessary expense in the issuance and distribution of publications of the Society, including cases where there is duplication of the printed matter. In this connection it is felt that approximately $15,000 can be saved annually in the printing and delivery of the TRANSACTIONS, and that this $15,000 can be used to much better advantage in broadening the Research and Standards work of the Society. The consensus of opinion among the Officers and the Council is that the greater part of the membership will not object to the transference of these available funds for the purposes above mentioned, if the TRANSACTIONS are made available at a nominal cost to the members who want them.

A resolution was therefore passed at the organization meeting of the 1922 Council for the purpose of eliminating the greater part of the expense of printing and mailing the TRANSACTIONS by making them available to members at $2 per part, there being two parts in each volume of annual TRANSACTIONS as now issued.

Practically all of the material contained in the TRANSACTIONS is preprinted in THE JOURNAL of the Society. It is therefore possible for members who do not wish to buy the TRANSACTIONS to save their JOURNALS for reference purposes. However, it would hardly pay a member to have his JOURNALS bound in preference to buying the TRANSACTIONS, because the cost of binding per volume would probably be more than $2.

Sufficient notice will be given in advance of printing so that all members who wish the TRANSACTIONS can get their orders in before the editions go to press.

Membership Roster

With regard to the Membership Roster, it was decided to eliminate the Company List and the Geographical List, thereby reducing the expense about one-half. In the future the Roster will contain an Alphabetical List only, and as a further measure of economy it will be sent to members only on request.

The Roster is now in process of manufacture. An order blank was sent out recently with one of the Chicago Meeting Bulletins. You are urgently requested to fill it out and return it to the office of the Society at once. Orders will be honored up to March 1, 1922. If you have not received or have mislaid the blank sent you, please use the blank printed on page 110 of this issue of THE JOURNAL.

IMPORTANT NOTICE

Do you want a Membership Roster?

If you wish to have your name and address correctly recorded in the 1922 Roster, please fill in, sign and return the attached blank at once.

Rosters will be sent only to those members who request them (See special notice on page 109). Your order must be received in the Society offices on or before March 1, 1922.

Name of company with which you are connected

....

Address of company

....
(Street and Number) (Town) (State)

What is your position or title? (State fully)

....

Where shall we address your mail?

....
(Street and Number) (Town) (State)

Of which Section are you a member?

....

I Do / Do Not } want a 1922 Membership Roster

....
Date (Print name in full)

Fill in on typewriter if practicable.

....
(Signature)

HAS BUSINESS REALLY TURNED THE CORNER?

(*Concluded from page* 101)

trial workers of one kind and another, today barely $1 is divided up among them. In other words, there is a shrinkage in what the urban workers and dwellers are getting out of that cotton of not far from $2.50.

In 1919 the United States used 3,000,000,000 lb. of cotton. Take a pencil and figure on that. There is a shrinkage today of at least $6,000,000,000 in the distributable income going to the urban classes and workers in the United States from the cotton used in the United States alone, as compared with 2 years ago.

Do you wonder that many people who would like to buy automobiles cannot buy them? Think of the people who are being hit by that; think of the people who have lost their jobs altogether because of it. What is true of cotton is true of copper; true of the products of iron and steel; true of any number of commodities turned into finished products by the various processes of manufacture.

The urban income of the United States has been squeezed I do not know how many billions of dollars in the last 2 years, and it is by that process that this readjustment that I have described as necessary and inevitable is actually coming about. Right there is to be sought the real reason for industrial unemployment in the United States. Does anybody doubt that, if it were possible to give every class of persons in the United States the same quantity of goods that they were taking in 1912 and 1913, there would be any unemployment in the Country to speak of?

What applies here applies also to Great Britain and her business on the Continent. Her exports today are running about 40 per cent in volume of what they were in 1913, and there is only one way in which they can be brought back and that is by bringing the prices down to the conditions of the classes of people that have to buy.

I think I have given you the main test that any one of you can apply to determine when business is actually on the point of turning the corner. I want to say this before I close. There are very many signs of a rather obscure kind, particularly in Europe, that the new situation is actually coming about. There are many signs in Europe that production and consumption are steadily rising. That is the best omen for the future that I know of, for, with goods, goods can be bought.

Research Information Service

A STRIKING illustration of the probable cost of *not* having research information readily and fully available is to be found in a statement of President Pritchett of the Carnegie Foundation for the Advancement of Teaching in which he reports that, on a visit in 1913 to the German Imperial Research Laboratories at Grosslichterfelde, he was informed that 80 *per cent* of all the problems sent to that laboratory and supposedly demanding experimental research were answered from their card-catalog of research information.

If any such percentage of proposed research undertakings in this Country is unnecessary because of previous work, information to this effect will result in aggregate savings out of all proportion to the time and cost of making the information available. Moreover, the ultimate object of the Society's Research Department, which is to secure through concerted effort along research lines more reliable technical information for the benefit of the industry, and to make this information more readily available to those interested in automotive problems, cannot be attained without first collecting the best possible information as to what has been accomplished and is now under way in the way of research applicable to our industry. To be sure, much of the information that is needed is in print. The collection of such information is merely a matter of time and patience, and an immense saving in both can result from a collection of this information by the Research Department for the benefit of the individual engineer. Much of the valuable information, however, is not in print, but is in the records of researches not yet published; in the back-files of laboratory notes and in the memories of men who have put in the time and energy necessary to solve some problem, perhaps in an emergency that has long passed, but which may arise for some other engineer.

Nor does even this cover the field of useful information as fully as it should be covered. Sometimes the most useful information is how *not* to do a thing. Information on the negative results or experimental failures seldom gets into print and not often into records. Nor do the plans and ideas for researches proposed or in progress become matters of record. The Research Department wants to make the fullest practicable use of such information by having records on file of not only what has been accomplished but also what general problems the various men and laboratories are interested in. When several members are interested in the same problems, they may find it very much worthwhile to work together. We

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ENGINE
- Structural problems.
- Carbureters and intake systems.
- Pressure and temperature cycles and measuring instruments.
- Friction losses.
- Exhaust system and mufflers.
- Cooling system, fan efficiencies, etc.
- Vibrations and balancing.
- Performance of complete powerplant units.
- Starting in cold weather.
- Exhaust-gas analysis.
- Combustion-chamber design.

CLUTCHES
- Structural problems.
- Materials, facings, etc.
- Methods of test.

TRANSMISSION
- Structural problems.
- Efficiencies and performance characteristics of sliding gear transmission.
- Lubrication and lubricants.
- Causes of noise.
- Other types of transmission.

REAR AXLES
- Structural problems.
- Efficiencies and performance characteristics.
- Brake systems and lining materials.

CHASSIS
- Structural problems.
- Performance.
- Steering systems.
- Four-wheel brakes.

BODY
- Design and structure.
- Painting and finishing.
- Wind-resistance.
- Causes of noise.

ASSEMBLED VEHICLE
- Tests of performance.
- Relation of weight and fuel economy.
- Comparative deterioration with pneumatic and solid tires.

FUELS AND FUEL ECONOMY
- Effect of fuel characteristics on economy.
- Mixture ratios required for economy.
- Physical and chemical properties of fuel.
- Permissible cylinder pressures.
- Phenomena of combustion.
- Effects of turbulence.
- Blended fuels—alcohol, benzol, alcogas, etc.
- Addition of water vapor and steam to mixture.
- Fuel-savers.
- Carbon formation and its disintegration or removal.
- Ignition-point of gaseous mixtures under different pressures.

LUBRICATION
- Lubricating systems.
- Laws of lubrication of bearings.
- Mechanical efficiencies.
- Rates of wear.
- Carbonization.
- "Body" of lubricants.
- Crankcase dilution.
- Contamination of oil by hydrocarbon fuels.
- Reclamation of oil.

ELECTRICAL SYSTEMS
- Lighting generators.
- Starting problems.
- Storage batteries.
- Headlamps and glare.

MISCELLANEOUS MATERIALS
- Special steels.
- Castings of iron and steel.
- Structural uses of light alloys.
- Paints and varnishes.
- Upholstery materials.
- Rust prevention.
- Metal plating.
- Bearing metals.
- Methods of detecting flaws in metals.
- Valve steels.
- Die-castings.
- Anti-freeze compounds.
- Hysteresis in metals.

MISCELLANEOUS PROBLEMS OF DESIGN
- Design and performance of gears.
- Dynamics of spring suspensions.
- Theory of wheel design.
- Balancing and harmonic vibration.
- Gyroscopic effects.

TIRES
- Tire efficiencies and methods of test.
- Effects of vehicle design on tire wear.
- Specification for rubber used in tires.

ACCESSORIES
- Piston-rings and pins.
- Speedometers.
- Fuel flow-meters.
- Time-pieces.
- Warning signals, etc.

MOTOR TRUCK PROBLEMS
- Structural problems.
- Road resistance.
- Grade resistance.
- Analyses of operating costs with relation to class of service and class of truck.
- Impact tests on roads.

TRACTOR PROBLEMS
- Structural problems.
- Performance and efficiencies.
- Air-cleaning.
- Oil dilution.
- Use of heavy fuels.
- Efficiencies of implements.
- Cooling fans and radiators—special.
- Overturning.
- Economic sizes of tractors.
- Cost analyses.

AERONAUTICS
- Aerodynamics of airplane structures.
- Navigation instruments and navigation.
- Relation of flying speed to landing speed.
- Multiple-engine problem.
- Propeller speeds and gear reduction.
- Radiator efficiencies.
- Fire hazard.
- Metal construction of planes.
- Materials of construction.

TOPIC CARD PREPARED BY THE RESEARCH DEPARTMENT

are referring now to fundamental researches rather than to development problems, which latter the Department does not wish to include.

As a first step in securing information as referred to above, letters have been written to all research laboratories and to such engineers as can be reached, requesting information that will serve as a preliminary survey of the present research situation. After the replies to these inquiries have been studied, they will be supplemented by personal visits to the laboratories in which active work is in progress.

The collection of this information will be of direct value to the individual engineer only so far as he makes use of it. To make the information as useful as possible, the Department has prepared a simple subject-index which is reproduced on this page. If you have not replied to a special letter from the Department regarding research information, or even if you have done so, and are interested in receiving from or in supplying to the Department research information along any of the lines indicated in the topic card or along any other lines, please write us accordingly.

The general aims and objects of the Research Department have been described so fully in previous issues of THE JOURNAL that more is hardly necessary. Our industry, like most others in the United States, has in the past underestimated the importance of fundamental research compared with development and sales practice, and it is to remedy this condition that the Research Department has been established. The Society is not alone in recognizing that the future development of industry in this Country is certain to be on a basis of keener competition with other nations and to require on our part more general application of fundamental scientific and technical information, the result of fundamental research. The demand for men who have been trained in fundamentals and in research methods has come to far exceed the supply even under present conditions when there are in general more men in search of employment than there are positions available.

The Research Department hopes to be of maximum value to the members of the Society and to the industry in increasing the efficiency of the research facilities that we have available. Such a result can be accomplished only with time and cooperative effort. We trust that you as members of the Society will remember that the research information service is being developed for your use, that its success depends upon both giving and receiving information and that you will both give and receive your share.

SULZER MARINE DIESEL ENGINE

RECENT developments have shown that the comparative failures of the early two-cycle marine Diesel engines, built some years ago, were not due to inherent defects in the principles involved, but were the results of unsatisfactory, yet remediable, features of design. It is now agreed almost universally that the valve scavenging engine is unsatisfactory for marine work, and it is significant that in the four leading types of two-cycle engine, the Sulzer, Doxford, Camellaird-Fullagar and Polar, port scavenging is employed. By this means the formation of cracks in the cylinder covers has been entirely eliminated, and that was one of the chief difficulties encountered in two-cycle marine engines before the war.

The Sulzer engine was one of the first in which port scavenging was employed, but the designers rapidly came to the conclusion that if the best results were to be achieved it was not desirable that free scavenging through ports uncovered by the piston in the course of its stroke should be adopted. In other words, although valves in the cylinder cover were to be avoided, some means of controlling the admission of the scavenging air through the ports at the bottom of the cylinders was essential. Naturally, with a single-piston engine, such as the Sulzer, it is much more difficult to obtain effective scavenging than in an opposed-piston type like the Doxford, in which the scavenging air may sweep right through the cylinder from the bottom to the top, and in which, moreover, the exhaust ports may be uncovered before the scavenging ports, thus allowing the pressure in the cylinder to drop to a very moderate figure before the scavenging air is admitted.

The builder of the Sulzer engine overcame the difficulty that thus presented itself by the adoption of two rows of scavenging ports, one vertically above the other and each occupying about half the periphery of the cylinder. The top row of ports reaches well above the top of the exhaust ports, and both sets are in communication with the main horizontal scavenging air trunk, which runs the whole length of the engine, and through which the air is delivered from the scavenging pump. While, however, the bottom row is in unobstructed communication with the scavenging trunk and allows air to enter the cylinders as the ports are uncovered by the piston, admission of air through the top row of ports is controlled by a rotary valve within the scavenging trunk. These rotary valves, there is one for each cylinder, are operated from a common shaft deriving its motion from a vertical shaft at the after end of the engine that drives the camshaft at the top of the engine. The pressure of scavenging air is low, under 2 lb. per sq. in., so that there is no trouble in maintaining the tightness of the valves, which might be a difficulty were the pressures employed for this purpose materially higher.

The result achieved by this arrangement is easily understood. The operation of the valves is controlled so that no scavenging air enters through the upper row of ports until the piston has nearly reached the bottom of its stroke. In the meantime the exhaust ports have been uncovered, the pressure in the cylinder has fallen and the admission of scavenging air through the bottom row of exhaust ports has commenced. After the piston has covered the exhaust port on its upward compression-stroke the upper set of scavenging ports remains open, and as scavenging air continues to enter the cylinder a very efficient supply is insured. The claim that this system conduces to low fuel-consumption appears to be borne out by official tests, for as low a figure as 0.418 lb. per b. hp-hr. is attained with a 1250-b. hp. engine driving its own auxiliary pumps. This is very little in excess of the consumption with normal four-cycle engine design. It is worthy of note in this connection that the Ansaldo San Giorgio Co. of Turin, which is building two-cycle marine engines with port scavenging, prefers to control the admission of the whole of the scavenging air and to have only one series of ports for its admission.

The Sulzer engine has a particular interest for English engineers and shipowners, since its construction has now been actively taken up by four prominent marine engineering firms, namely, Armstrongs, the Wallsend Slipway & Engineering Co., Denny Bros., and Alexander Stephen & Sons. Its application to marine work is therefore likely to be extensive, and it is noteworthy in view of the discussion that is now so frequently heard concerning the possibility of a shortage of oil fuel that the builders of the Sulzer Diesel engine claim that it will run satisfactorily on fuel oil such as is burnt under boilers. The consumption when using Mexican fuel oil is 0.447 lb. per b. hp-hr. against 0.418 lb. with gas oil, the thermodynamic efficiencies being 32 and 33 per cent respectively.—*The Engineer* (London).

Personnel of 1922 Standards Committee

THE designation of the Standards Committee personnel for this year has been completed, the Council having taken action considerably earlier than in previous years. The prompt formation of the 1922 Divisions will enable them to begin active work soon.

The Standards Committee for 1922 will be constituted of 27 Divisions. It is believed that these will form in the main a permanent group some one or more of which can be assigned practically any subject that the Council may approve for consideration in connection with standardization. Some of the Divisions will, of course, be more active than others at certain times. The total number of members of the committee will be about 20 per cent greater than that of last year. In reorganizing several of the Divisions an effort has been made to provide added representation of the "user" class of appointees to balance more nearly the "producer" class.

STANDARDS COMMITTEE

E. A. Johnston, *Chairman*
W. G. Wall, *Vice-Chairman*
C. M. Manly, *Vice-Chairman*

AERONAUTIC DIVISION

H. M. Crane, *Chairman*	Consulting Engineer
G. J. Mead, *Vice-Chairman*	Wright Aeronautical Corporation
V. E. Clark	General Motors Research Corporation
W. L. Gilmore	Curtis Engineering Co.
L. M. Griffith	National Advisory Committee for Aeronautics
G. E. A. Hallett	Air Service
J. L. Harkness	L. W. F. Engineering Co.
J. C. Hunsaker	Navy Department
B. G. Leighton	Navy Department
L. B. Lent	Aerial Transportation Corporation
G. C. Loening	Loening Aeronautical Engineering Corporation
Glenn L. Martin	Glenn L. Martin Co.
W. H. Phipps	Ordnance Engineering Corporation
H. C. Richardson	Naval Aircraft Factory
C. I. Stanton	Post Office Department
W. T. Thomas	Thomas-Morse Aircraft Corporation
R. H. Upson	Gardner-Moffat Co.
P. W. Wittemann	Wittemann-Lewis Aircraft Co., Inc.

AGRICULTURAL POWER EQUIPMENT DIVISION

John Mainland, *Chairman*	Advance-Rumely Co.
C. B. Rose, *Vice-Chairman*	Moline Engine Co.
D. L. Arnold	International Harvester Co.
J. B. Bartholomew	Avery Co.
J. H. Davis	General Motors Research Corporation
A. H. Gilbert	Rock Island Plow Co.
R. O. Hendrickson	J. I. Case Plow Works
M. B. Morgan	Cleveland Tractor Co.
A. W. Scarratt	Minneapolis Steel & Machinery Co.
O. W. Sjogren	University of Nebraska
William Turnbull	Holt Mfg. Co.
L. W. Witry	Waterloo Gas Engine Co.
G. A. Young	Purdue University

AXLE AND WHEEL DIVISION

G. W. Dunham, *Chairman*	Savage Arms Corporation
C. C. Carlton, *Vice-Chairman*	Motor Wheel Corporation
R. S. Begg	Jordan Motor Car Co.
T. V. Buckwalter	Timken Roller Bearing Co.
A. C. Burch	Clydesdale Motor Truck Co.
R. J. Burrows	Clark Equipment Co.
L. W. Close	Bock Bearing Co.
J. Coapman	Russel Motor Axle Co.
C. S. Dahlquist	Eaton Axle Co.
F. S. Denneen	Grant Motor Car Co.
F. W. Gurney	Gurney Ball Bearing Co.
F. P. Hall, Jr.	Salisbury Axle Co.
G. W. Harper	Columbia Axle Co.
G. L. Lavery	West Steel Casting Co.
A. M. Laycock	Sheldon Axle & Spring Co.
H. V. Ludwick	Budd Wheel Corporation
C. T. Myers	Consulting Engineer
A. L. Putnam	Detroit Pressed Steel Co.
H. Vanderbeek	Timken-Detroit Axle Co.

BALL AND ROLLER BEARINGS DIVISION

F. W. Gurney, *Chairman*	Gurney Ball Bearing Co.
C. M. Manly, *Vice-Chairman*	Manly & Veal
G. R. Bott	Norma Co. of America
H. E. Brunner	S. K. F. Industries, Inc.
T. V. Buckwalter	Timken Roller Bearing Co.
E. R. Carter, Jr.	Fafnir Bearing Co.
D. F. Chambers	Bearings Co. of America
L. W. Close	Bock Bearing Co.
L. A. Cummings	Standard Steel & Bearings, Inc.
G. W. Dunham	Savage Arms Corporation
R. G. Hendricks	King Motor Car Co.
F. G. Hughes	New Departure Mfg. Co.
G. L. Miller	Gilliam Mfg. Co.
A. J. Scaife	White Motor Co.
R. G. Schaffner	Bower Roller Bearing Co.
W. R. Strickland	Consulting Engineer
R. E. Wells	Hyatt Roller Bearing Co.

Roller Bearings Subdivision

C. M. Manly, *Chairman*	Manly & Veal
G. R. Bott	Norma Co. of America
L. W. Close	Bock Bearing Co.
G. W. Dunham	Savage Arms Corporation
C. T. Hagenlocher	Wright Roller Bearing Co.
L. R. Heim	Ball & Roller Bearing Co.
R. G. Hendricks	King Motor Car Co.
G. L. Miller	Gilliam Mfg. Co.
H. J. Porter	Timken Roller Bearing Co.
R. G. Schaffner	Bower Roller Bearing Co.
C. W. Spicer	Spicer Mfg. Corporation

CHAIN DIVISION

W. F. Cole, *Chairman*	Baldwin Chain & Mfg. Co.
H. S. Pierce, *Vice-Chairman*	Link-Belt Co.
D. B. Baker	International Harvester Co.
W. J. Belcher	Whitney Mfg. Co.
E. S. Corcoran	Kelly-Springfield Motor Truck Co.
H. F. L. Funke	H. F. L. Funke Co., Inc.
M. C. Horine	International Motor Co.
J. C. Howe	American High Speed Chain Co.
L. M. Wainwright	Diamond Chain & Mfg. Co.

ELECTRIC VEHICLE DIVISION

E. L. Clark, *Chairman*	Commercial Truck Co.
Karl Probst, *Vice-Chairman*	Milburn Wagon Co.
G. L. Bixby	Detroit Electric Car Co.

J. G. Carrol	Walker Vehicle Co.
H. M. Pierce	Ward Motor Vehicle Co.
F. E. Queeney	Lansden Co., Inc.

ELECTRICAL EQUIPMENT DIVISION

F. W. Andrew, *Chairman*	Eisemann Magneto Corporation
T. L. Lee, *Vice-Chairman*	North East Electric Co.
Azel Ames	Kerite Insulated Wire & Cable Co.
G. S. Cawthorne	Master Trucks, Inc.
W. A. Chryst	Dayton Engineering Laboratories Co.
S. F. Evelyn	Continental Motors Corporation
C. F. Gilchrist	Electric Auto-Lite Corporation
W. S. Haggott	Packard Electric Co.
C. H. Kindl	Westinghouse Electric & Mfg. Co.
F. C. Kroeger	Remy Electric Co.
B. M. Leece	Leece-Neville Co.
A. D. T. Libby	Splitdorf Electrical Co.
Charles Marcus	Bijur Motor Appliance Co.
Ernest Wooler	Cleveland Automobile Co.

ENGINE DIVISION

J. B. Fisher, *Chairman*	Waukesha Motor Co.
R. J. Broege, *Vice-Chairman*	Buda Co.
P. J. Dasey	Midwest Engine Co.
S. F. Evelyn	Continental Motors Corporation
J. A. Kraus	Garford Motor Truck Co.
H. B. Massey	Holmes Automobile Co.
A. F. Milbrath	Wisconsin Motor Mfg. Co.
Louis Schwitzer	Automotive Parts Co.
M. J. Steele	Packard Motor Car Co.

FRAMES DIVISION

E. V. Rippingille, *Chairman*	Watson Stabilator Co.
L. J. Fralick, *Vice-Chairman*	Hydraulic Pressed Steel Co.
C. C. Bowman	Standard Motor Truck Co.
O. B. Harmon	Parish & Bingham Co.
E. L. Larson	Locomobile Co.
W. A. McKinley	Detroit Pressed Steel Co.

IRON AND STEEL DIVISION

F. P. Gilligan, *Chairman*	Henry Souther Engineering Corporation
W. C. Peterson, *Vice-Chairman*	Atlas Crucible Steel Co.
R. M. Bird	Bethlehem Steel Co.
H. T. Chandler	C. H. Wills & Co.
A. L. Colby	American Society for Testing Materials
L. A. Danse	Cadillac Motor Car Co.
C. N. Dawe	Studebaker Corporation of America
B. H. DeLong	Carpenter Steel Co.
A. P. Eves	International Harvester Co.
E. L. French	Crucible Steel Co. of America
H. L. Greene	Willys-Overland Co.
C. G. Heilman	General Motors Corporation
E. J. Janitzky	Illinois Steel Co.
J. B. Johnson	Air Service
F. C. Langenberg	Ordnance Department
A. H. Miller	Midvale Steel & Ordnance Co.
C. S. Moody	Minneapolis Steel & Machinery Co.
J. H. Nelson	Wyman-Gordon Co.
G. L. Norris	Vanadium Corporation of America
M. P. Rumney	Detroit Steel Products Co.
C. F. W. Rys	Carnegie Steel Co.
R. B. Schenck	Buick Motor Co.
M. H. Schmid	United Alloy Steel Corporation
H. J. Stagg	Halcomb Steel Co.
J. M. Watson	Hupp Motor Car Corporation
J. H. G. Williams	Billings & Spencer

ISOLATED ELECTRIC LIGHTING PLANT DIVISION

E. B. Newell, *Chairman*	Westinghouse Electric & Mfg. Co.
F. C. Barton	General Electric Co.
L. F. Burger	International Harvester Co.
G. M. Gardner	Globe Electric Co.
Bryan T. Hawley	Holt Power Light Co.
L. S. Keilholtz	Delco-Light Co.
C. H. Parker	Lalley Light Corporation
C. E. Reddig	Western Electric Co.
F. L. Tubbs	Alamo Farm Light Co.
Samuel Wilbur	Sunbeam Electric Mfg. Co.

LIGHTING DIVISION

W. A. McKay, *Chairman*	Westinghouse Lamp Co.
C. A. Michel, *Vice-Chairman*	Guide Motor Lamp Mfg. Co.
J. T. Caldwell	General Electric Co.
C. E. Godley	Edmunds & Jones Corporation
C. A. B. Halvorson, Jr.	General Electric Co.
L. C. Porter	Edison Lamp Works
E. S. Preston	Chicago Electric Mfg. Co.
C. D. Ryder	Corcoran-Victor Co.
C. H. Sharp	Electrical Testing Laboratories
J. C. Stearns	Culver-Stearns Mfg. Co.
T. I. Walker	General Electric Co.
W. W. Wood	Miniature Incandescent Lamp Corporation
Ernest Wooler	Cleveland Automobile Co.

LUBRICANTS DIVISION

H. C. Mougey, *Chairman*	General Motors Research Corporation
W. E. Jominy, *Vice-Chairman*	Studebaker Corporation of America
Sydney Bevin	Tidewater Oil Sales Co.
P. J. Dasey	Midwest Engine Co.
A. P. Eves	International Harvester Co.
W. H. Herschel	Bureau of Standards
W. E. Perdew	Union Petroleum Co.
H. G. Smith	Atlantic Refining Co.
J. W. Stack	Standard Oil Co.

MOTORBOAT DIVISION

Joseph VanBlerck, *Chairman*	Wellman-Seaver-Morgan Co.
H. H. Brautigam, *Vice-Chairman*	Bridgeport Motor Co.
Irwin Chase	Elco Works
G. F. Crouch	Webbs' Academy and Home for Shipbuilders
G. C. Davison	New London Ship & Engine Co.
W. J. Deed	*Motorship*
Kirk Dyer	Frisbie Motors Co.
Q. B. Newmann	Coast Guard Service
Leonard Ochtman	Wellman-Seaver-Morgan Co.
F. B. Sexton	Sexton Motor Co.

MOTORCYCLE DIVISION

C. B. Franklin, *Chairman*	Hendee Mfg. Co.
F. W. Schwinn, *Vice-Chairman*	Excelsior Motor Mfg. & Supply Co.
W. S. Harley	Harley-Davidson Motor Co.
A. W. Herrington	Quartermaster Corps

NOMENCLATURE DIVISION

H. L. Pope, *Chairman*	Wright Aeronautical Corporation
W. P. Kennedy, *Vice-Chairman*	Consulting Engineer
W. F. Borgerd	International Harvester Co.

W. J. Brandon	Avery Co.
W. S. Brouton	Hendee Mfg. Co.
H. R. Cobleigh	National Automobile Chamber of Commerce
G. F. Crouch	Webb's Academy and Home for Shipbuilders
A. B. Cumner	Autocar Co.
L. S. Keilholtz	Delco-Light Co.
V. E. McMullen	Hercules Gas Engine Co.
W. T. Thomas	Thomas - Morse Aircraft Corporation
William Turnbull	Holt Mfg. Co.
J. G. Vincent	Manufacturers' Aircraft Association

NON-FERROUS METAL DIVISION

Charles Pack, *Chairman*	Doehler Die-Casting Co.
W. B. Price, *Vice-Chairman*	Scovill Mfg. Co.
W. H. Bassett	American Brass Co.
A. G. Carman	Franklin Die-Casting Corporation
D. L. Colwell	Stewart Mfg. Co.
G. K. Elliott	Lunkenheimer Co.
J. R. Freeman, Jr.	Bureau of Standards
E. S. Fretz	Light Mfg. & Foundry Co.
A. J. Hall	General Motors Corporation
Zay Jeffries	Aluminum Manufactures, Inc.
H. C. Mougey	General Motors Research Corporation
G. C. Ranhauser	Denby Motor Truck Co.
J. F. Thompson	International Nickel Co.
W. R. Webster	Bridgeport Brass Co.

PARTS AND FITTINGS DIVISION

F. G. Whittington, *Chairman*	Stewart-Warner Speedometer Co.
W. C. Keys, *Vice-Chairman*	Eaton Axle Co.
Clarence Carson	Dodge Bros.
E. R. Douglas	Cincinnati Ball Crank Co.
H. B. Garman	Steel Products Co.
H. S. Jandus	C. G. Spring Co.
F. W. Slack	Peerless Motor Car Co.
C. W. Spicer	Spicer Mfg. Corporation
Alex. Taub	General Motors Corporation

PASSENGER CAR DIVISION

R. S. Begg, *Chairman*	Jordan Motor Car Co.
L. A. Chaminade, *Vice-Chairman*	Studebaker Corporation of America
A. M. Dean	Templar Motors Corporation
A. W. Frehse	Standard Steel Car Co.
Maurice Olley	Rolls-Royce of America, Inc.
L. M. Stellmann	H. H. Franklin Mfg. Co.
J. H. Tuttle	Westcott Motor Car Co.

PASSENGER-CAR BODY DIVISION

G. E. Goddard, *Chairman*	Dodge Bros.
A. J. Neerken, *Vice-Chairman*	Hupp Motor Car Corporation
E. G. Budd	E. G. Budd Mfg. Co.
J. S. Burdick	Buffalo Body Corporation
F. C. Chapman	Brewster & Co.
O. H. Clark	Willys Corporation
A. E. Garrels	Studebaker Corporation of America
E. W. Goodwin	Consulting Engineer
G. W. Kerr	Rolls-Royce of America, Inc.
G. J. Mercer	Consulting Engineer
H. C. Nelson	Mullins Body Corporation

RADIATOR DIVISION

J. D. Harris, *Chairman*	McCord Mfg. Co., Inc.
C. S. Sage, *Vice-Chairman*	Sage Radiator Co., Inc.
D. L. Britton	Templar Motors Corporation
H. A. Higgins	Long Mfg. Co.
H. B. Knap	Packard Motor Car Co.
Charles Oppe	G. & O. Mfg. Co.
C. T. Perkins	Modine Mfg. Co.
G. H. Pettit	Atterbury Motor Car Co.
K. F. Walker	Fedders Mfg. Co.
J. A. White	Harrison Radiator Co.
J. G. Zummach	Zummach Engineering Service

SCREW THREADS DIVISION

E. H. Ehrmann, *Chairman*	Chicago Screw Co.
O. B. Zimmerman, *Vice-Chairman*	International Harvester Co.
Earle Buckingham	Niles-Bement-Pond Co.
E. Burdsall	Russell, Burdsall & Ward Bolt & Nut Co.
Luther Burlingame	Brown & Sharpe Mfg. Co.
G. S. Case	Lamson & Sessions Co.
W. R. Mitchell	National Acme Mfg. Co.
Alex. Taub	General Motors Corporation

SPRINGS DIVISION

S. P. Hess, *Chairman*	Detroit Steel Products Co.
H. R. McMahon, *Vice-Chairman*	Standard Steel Spring Co.
R. S. Begg	Jordan Motor Car Co.
E. S. Corcoran	Kelly-Springfield Motor Truck Co.
H. E. Figgie	Perfection Spring Co.
W. M. Newkirk	William & Harvey Rowland, Inc.
Gustof Peterson	Electric Alloy Steel Co.
E. V. Rippingille	Watson Stabilator Co.
F. A. Whitten	General Motors Truck Co.

STATIONARY ENGINE DIVISION

T. C. Menges, *Chairman*	Associated Manufacturers Co.
L. F. Burger, *Vice-Chairman*	International Harvester Co.
H. N. Edens	John Lauson Mfg. Co.
H. G. Holmes	Novo Engine Co.
V. E. McMullen	Hercules Gas Engine Co.
I. J. Nelson	Nelson Bros.
O. A. Powell	Cushman Motor Works
L. W. Witry	Waterloo Gasoline Engine Co.

STORAGE BATTERY DIVISION

W. E. Holland, *Chairman*	Philadelphia Storage Battery Co.
I. M. Noble, *Vice-Chairman*	Consulting Engineer
G. L. Bixby	Detroit Electric Car Co
R. N. Chamberlain	Gould Storage Battery Co.
E. L. Clark	Commercial Truck Co.
Bruce Ford	Electric Storage Battery Co.
C. T. Klug	Willard Storage Battery Co.
R. C. Mitchell	Edison Storage Battery Co.
W. G. Wall	National Motor Car & Vehicle Co.

TRANSMISSION DIVISION

A. C. Bryan, *Chairman*	Durston Gear Corporation
L. C. Fuller, *Vice-Chairman*	Fuller & Sons Mfg. Co.
A. W. Copland	Detroit Gear & Machine Co.
A. M. Dean	Templar Motors Corporation
J. B. Foote	Foote Bros. Gear & Machine Co.
D. E. Gamble	Borg & Beck Co.
A. A. Gloetzner	Covert Gear Co., Inc.
C. O. Guernsey	Service Motor Truck Co.
Joseph Jandesek	Republic Motor Truck Co.
W. C. Lipe	Brown-Lipe Gear Co.

C. E. Swenson	Mechanics Machine Co.
S. O. White	Warner Gear Co.

TRUCK DIVISION

F. A. Whitten, *Chairman*	General Motors Truck Co.
A. J. Scaife, *Vice-Chairman*	White Motor Co.
A. K. Brumbaugh	Autocar Co.
G. S. Cawthorne	Master Trucks, Inc.
J. R. Coleman	Selden Truck Corporation
F. W. Davis	Pierce-Arrow Motor Car Co.
H. E. Derr	International Harvester Co.
C. O. Guernsey	Service Motor Truck Co.
A. W. Herrington	Quartermaster Corps
M. C. Horine	International Motor Co.
H. B. Knap	Packard Motor Car Co.
C. B. Veal	Manly & Veal

LAW OF SUPPLY AND DEMAND

As the years go by and a better understanding is had of the actual workings of economic forces, more and more industries are realizing the necessity of studying the relation of supply to demand for their own products. Consequently they organize statistical bureaus to gather this information as to past years so that the experience of the past will be as much a gage as possible for the future and also for the present demand so as to know the flow and the relative levels in the various tanks. It is true that some of these organizations still seem to have the fallacious idea that somehow they can, by concerted action, regulate the flow. Society is benefited by close regulation of supply to demand, by not having plants built that are actually unnecessary and by using the capital that would be thus wasted in providing facilities for producing other goods. But no organization can deliberately regulate that flow any more than any socialist bureaucrat sitting in a Government office can do it.

Society must have a free market, one in which every buyer has access to every seller, and vice versa. The freer the market is, the better will competition take care of regulation. Perfectly free competition involves intelligent competition. If every company were fully informed as to costs of production in its own line, and if every buyer were equally well informed, then prices would be proper for both sellers and buyers. The buyer would expect to pay enough for his goods to cover their costs and the seller's fair profit; and the seller would not expect to get more profit than the buyer ought to pay him to produce the goods under given circumstances. As it is now, the difficulty lies in not enough information being available to either consumers or sellers to enable them to gage the market and to adjust their respective bid and asked prices to actual conditions.

Some firms set their prices in flush times on a basis of low costs at maximum capacity of their plants, and a small unit profit at that rate of production. The fact is that due to the waves, long-time costs actually rest on a basis of considerably less production year in and year out. When that kind of a seller goes out in the market he commits either business murder or business suicide by quoting prices that are lower than the economic level demands. If a price is not realized at such times that will provide a reserve to meet the next depression the company has to dip into its original capital to tide it over the gap in demand.

There is nothing in the law that does or should prevent intelligent competition. There is nothing to prevent a man from having full information as to the market that he is attempting to reach. Such information is manifestly for the benefit of society as a whole, and both buyers and sellers should have free access to it. The law does say, and properly, that there should be no artificial restraint of the market. Even if there were no law to condemn artificial restrictions and interferences with competition, such practices are unwise and uneconomic, and such restrictions always carry within themselves the seeds of their own dissolution. Those who try such restraints endeavor to work against economic law, as well as against statute law. This cannot be successful economics because it is unsound economics, and should be abandoned for that reason if for no other. Cutthroat competition is just as uneconomic, and brings its own penalty by compelling the competitor to retaliate to preserve his own existence, and the cut-throat loses more than he can possibly gain. Here again, what is perfectly good economics is strictly in accord with the Golden Rule.—E. F. Dubrul in *American Machinist.*

INDUSTRIAL CONDITIONS IN EUROPE

INDUSTRIAL affairs in England are somewhat complicated by their socialistic experiments, most of which have failed to accomplish what was expected of them. For example, the attempt to solve the problem of unemployment by payments based on idleness rather than on work is an economic failure. Not only in England and France but in Russia people are beginning to realize that the millennium is not to be brought about through governmental agencies, but rather through the orderly operation of economic laws. England, the greatest trading nation in the world, knows what competition is, knows that her future depends upon foreign trade and is preparing to meet it in her own shops and with her own ships.

France is fundamentally an agricultural country, a country of well-to-do peasants, and as such is more prosperous than we have been led to believe. Of course the manufacturing industry is at a low ebb but unemployment is not marked, and I was told that the men out of work in industry were back on the farms where they work for food and lodging so that foodstuffs are produced more cheaply and prosperity gets its fundamental start. The French know how to live cheaply and when times are good they save money.

In Germany it appeared to me that conditions were better than in any other country I visited. Not only are they not looking for any outside help such as the allied countries may expect from reparations, but they do not seem to be worrying about the reparations, and it appeared to me that they do not seem to believe they will ever be forced to pay or if at all not in any way that would inconvenience them to any great extent. Germany, of course, is a great manufacturing and industrial country and while France and England are industrially flat German industry is comparatively prosperous. With the mark at so low an exchange value they can undersell any other country, and realizing in a sense that they were defeated temporarily in their ambitions, their workmen are willing to take what they can get. Their factories are uninjured and in a high state of efficiency.

It seems to me that the European people learned from the war a lesson of real sacrifice and with the dangers that confront them recognize that they must continue to sacrifice to work back to more normal conditions.—A. C. Higgins in *American Machinist.*

Body Seating-Dimensions

By George E. Goddard[1]

Annual Meeting Paper *Illustrated with* Drawing

THE dimensions of automobile-body seats receive consideration with regard to the features that are conducive to comfort. A diagram is presented upon which the dimensions treated are indicated, and a tabulation of seat dimensions of 12 representative cars is included.

Comments are made upon the factors influencing seat dimensions, as well as recommendations regarding the different desirable dimensions. The considerations are inclusive of cushion height, depth and slope, leg-room and head-room, upholstery shape and softness of trimming, foot-rest and other control-element locations, factors influencing entrance and egress provisions, seat widths and advisable front and rear-compartment heights.

The author recommends the standardization of a range of locations for the different control elements.

THE subject of body seating-dimensions is liable to variations of opinion and, undoubtedly, this is legitimate. Naturally, we do not all agree upon what constitutes the most comfortable chair; if we did, we might all be buying the same chair. Therefore, body seating-dimensions are not a subject for standardization; they can, however, be given very serious consideration and the intention of this paper is to elucidate certain necessary features conducive to comfort.

Cushion Height, Depth and Slope

The mode of women's dress is of prime importance. It is very fortunate for the body designer that women are wearing shorter skirts at present, and that they girdle themselves with a support of minimum proportions, particularly as to vertical dimensions. Seat-cushion heights are now, or can be made, as low as is necessary to secure the assumption of a comfortable sitting position, or to arise from that to a standing position; in other words, it is necessary that the passenger be able to sit down and to arise easily and naturally.

I will call the space in front of the seat "leg-room." Naturally, this space must be increased to conform to the lowered sitting position. It is here that one of the greatest variations in seating dimensions occurs. When this leg-room is restricted, the final position must be made comfortable by incorporating the proper slope in the cushion and the corresponding slant in the seat-back. It has been stated that the semi-reclining position attained in the deck chair, so common on ocean liners, is the ideal. This may be entirely correct, but I doubt if it can be duplicated in conservative motor-body design. However, it can and should be approached in the passenger car, because it contributes to the attainment of a horizontal line of vision that is more nearly equal in elevation to that of an individual who has assumed a standing position. The more nearly the eye-line height of the passengers is brought to that of a person who is walking, the more they will be at ease, if for no other reason than that man's work is carried out mainly from this viewpoint.

The depth of the cushion, from front to back, is affected by both the height and the leg-room. If the latter is not restricted, the slope can be made slight and the depth greater. If it becomes necessary to draw the legs back, the knees are raised and the body must be supported by the cushion at a greater slope. In coming back, the calves of the legs would interfere with the front of the cushion and it must be made more shallow. The seat-back must be slanted more, the back springs slightly stiffened and the "foot-rest position" located within comfortable reach. These seem to be the elements to be given major consideration. I recommend 12 in. at the front of the cushion as a good compromise position, with a minimum depth of 17 in. on a 2-in. slope and a minimum back-height of 17 in.; also, for the rear seat, a 14-in. height at the front of the cushion, with a minimum depth of 19 in. on a 2-in. slope and a minimum back-height of 19 in. These dimensions are, of course, dependent upon the pedal position from the front edge to the cushion of 19 in. and a foot-rail position of 18 in., measured correspondingly, and reference is made to Fig. 1 and to the last line of figures in the tabulation. It has been found preferable to have rear-seat passengers ride slightly higher than those in the front seat, to secure clearer forward vision. The 2 in. recommended, when combined with the slope of the chassis, which should be from 1 to 2 in. with a full complement of passengers, is sufficient under average conditions.

Upholstery Shape

To deviate for the moment from the actual dimensions of seats, the correct shaping of the seat, the upholstery contour, is of far greater importance than either its proportions or softness. The dimensions may be such as to provide a well-proportioned seat, and yet it may be a very uncomfortable seat for even a short ride. The angular relation of the cushion and the back upholstery must be right. This relation will vary somewhat with the height of the cushion and the foot-rest position, but the angle will average about 95 deg. The cushion should have an approximately flat slope, but the back upholstery shape must have a properly curved contour. This contour naturally does not vary to a great extent as to characteristic shape regardless of the height, depth or slope of the cushion, or the height of the back upholstery itself. It is obvious that the occupant's back must be supported, but proper support is lacking in a great many seat-backs. If, when seated, one's back can "cave out," there are very few who can ride 10 blocks in comfort; but, if one's back is properly supported against curvature, one could drive or ride for a four-day 1000-mile trip and feel sufficiently fit at the finish to turn around and do it again. Strange to say, the average trimmer fails to produce this desirable shape without considerable coercion, and particularly a properly graduated resistance to prevent curvature. The back upholstery must be shaped so as to have a prominence of the proper resistance, and be at the proper height from the cushion to fit the small of one's back. It must, nevertheless, taper off toward the top to

[1] M.S.A.E.—Assistant chief engineer, Dodge Bros., Detroit.

provide ample shoulder-freedom. This is particularly important for the person at the wheel. The resistance at this point can be fairly stiff and yet be comfortable. In fact that supposed 1000-mile ride depends upon making it stiff. There should be very little movement of one's back at this point; the movement should occur at the hips. The driver needs this resisting prominence in particular, to enable him to attain a confident and comfortable operation of the clutch and brake-pedals, if for no other reason. Without attempting to give details of the layout of this shape, I would say that the gradation of the springs of four-row backs can be made so that the bottom row has No. 13, the main row No. 12, the third row No. 13 and the top row No. 14 springs. However, this can all be laid out on paper. From this, drawings and specifications of the back-spring construction, as well as of the cushion, the back and the final inspection templates, can be determined.

Softness of trimming is controlled to a great extent by the trimmer but, if the final contour of the combined cushion and back is obtained, together with a properly related foot-rest position, the slight variation occurring as to softness is inconsiderable. If it is to be featured, softness should be obtained in the spring construction almost entirely, especially in the straight-pleated type. The cushion top should be firm, to enable it to endure for proper length of time.

Position of Foot-Rest, Steering-Wheel and Controls

The term "foot-rest position" has been used as applying to the brake and clutch-pedals and to the foot-rail. It applies also, and perhaps more particularly, to the accelerator-pedal. It is obvious, then, that the last-named should be located at a slightly greater distance than the other pedals for, when operating clutch or brake, sufficient freedom of movement between the thigh and the cushion must be allowed for, when determining the slope of the cushion. Since the accelerator-pedal has less effective travel, it must be positioned to take up practically all of this freedom in order that the thigh be comfortably supported along the entire length of the cushion slope. An accelerator-pedal toe-rest cannot accomplish this; it can merely produce ankle comfort. The height H of the pedal-pads from the floor, as shown in Fig. 1, is a dimension that deserves much study. How the improper position of some of the existent pedal-pads has been arrived at, is a mystery. I suggest that the Society formulate a diagram of control dimensions locating pedal-pads, lever-grips, the handles and knobs on the instrument-board, and the like, from the center of the bottom of the steering-wheel rim. The height of the foot-rail L should be such that the front of a man's shoe heel can be braced underneath the lower edge. This height will then be such that the ball of a woman's foot will rest usually on the center of the rail. The slope of the toe-board should be approximately at right angles to the calf of the leg, located so that the thigh rests along the entire length of the cushion slope and within comfortable reach. The sitting position should be determined properly, regardless of the control.

It has been shown how the pedals should be located in relation to the seat. The steering-wheel and hand-levers should be treated in the same manner. I recommend a minimum distance below the wheel of 8 in. and a space of 15 in. to the back upholstery, as indicated by the letters I and J in Fig. 1.

The arm-rest position also must be given due consideration. On open cars, the height of the body side properly should be determined from this viewpoint, unless the seat width is sufficient to provide a built-in arm-rest. A minimum of 9 in. is recommended.

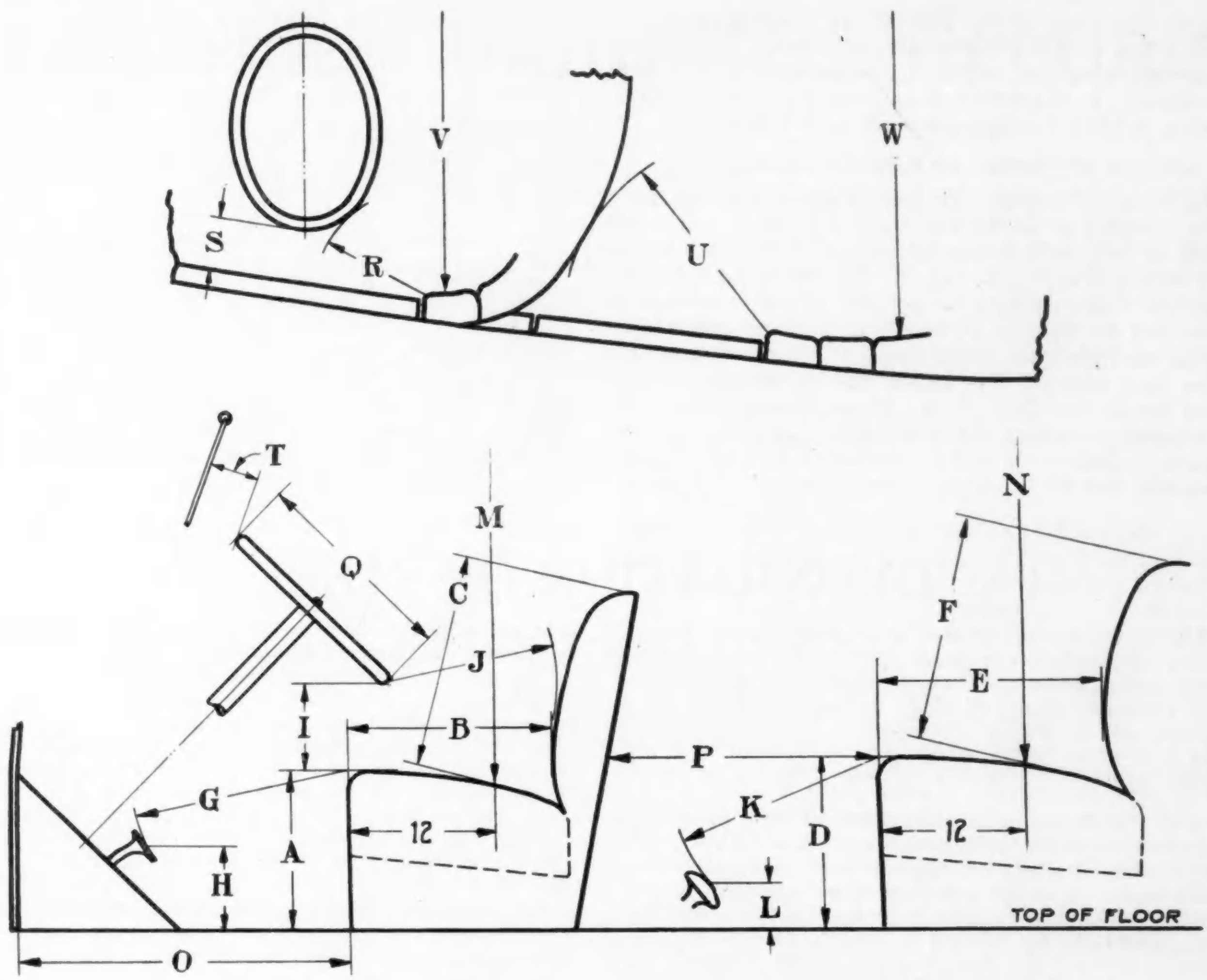
Head-Room

Head-room is a fairly well-established dimension. Where the door width is ample and the running-board is positioned properly, the entering and leaving of the car is accomplished without assuming even a stooping position. The head-room at the front seat can be less than that at the rear, being between axles. The greater range of chassis spring-action at the rear makes it advisable to provide slightly more head-room over the rear cushion. The minimum to be recommended for the front seat is 37 in. and, for the rear, 38 in., measured vertically at a point 12 in. back of the front edge of the cushion and 8 in. from the side of the body, as indicated by the letters M and N in Fig. 1. Although but 36 in. has been provided in some bodies, this dimension generally is accompanied by an unusually soft cushion.

The entering and leaving of the car has been mentioned in connection with door widths and the like, but the actual clearance between the parts of the structure is the true viewpoint to assume for such considerations. For instance, the distance between the corner of the front seat, or a curved partition, to the rear-door hinge-pillar must provide a comfortable "hip clearance." A minimum of 17 in. is recommended, as indicated by the letter U in Fig. 1. This dimension will provide sufficient shoulder-clearance, although more room than this is desirable, particularly if the door is hinged on the front pillar. For entrance to the front seat, "shoulder-clearance" should be considered in connection with the slanted windshield or body front. When using the wheel side for entering or leaving the car, ample leg or "body-clearance" should be provided between the wheel and the seat-arm or front-door rear-pillar. A minimum of 9 in. is recommended for open bodies, as indicated by the letter R in Fig. 1. This should be slightly greater on closed bodies and in both open and closed types, where the front door is hung on the rear pillar. Of course, where the body space is limited, this can be accomplished with the aid of a sliding or tilting steering-wheel.

Seat Width

The width of seats varies from 37 to 42 in. for front seats, as shown in the tabulation in Fig. 1. This dimension is determined more by body design than from the standpoint of proper space for two passengers. While 16 in. of cushion space is sufficient for the average person, a minimum shoulder-space of 18 in. should be allowed for passengers. For the driver, I prefer to provide a 21-in. shoulder-space to allow ample freedom of arm movement. A front-seat width of 40 in. will satisfy these requirements and, with the steering-column 10 in. from the center-line of the car, the driver will be able to sit directly behind the wheel. It is true that many bodies can be found that are narrower at this point, but too sudden a contraction cramps the left-arm movement of the driver. The inside measurement of the body, taken across the center of the steering-wheel, should not be less than 45 in. The space S will then be but 4 in. when a 17-in. wheel is provided on a column in the location already stated, as shown in Fig. 1. I have driven cars that it hardly would have been safe to have driven in congested traffic or in unusually bad going if the front window had not been lowered or the door curtain left off. Cramping at this point should not be encouraged, at least. The hand-clearance between the wheel and the windshield should not be less than 3 in., although this



O	11	16	17	12	18	18	17	6	6 1/2	14	16	3	36	37	28	21	17	9	4	3	16	38	45	
No.	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**WB**
1	11	16	16 1/4	14 3/4	19	18	18 1/2	varies 6 to 9	6 1/4	15 1/2	varies 17 to 21	varies 3 to 4 1/2	varies 36 to 38	varies 37 to 40	31	25	varies 16 to 20	varies 8 to 12	varies 4 to 8	varies 3 to 10	16 1/2	38 1/4	46	112 1/2
2	12 1/2	17	17 1/2	15	19	18	18		7 1/2	14					31	22					16	38	45	112 1/2
3	15	18	18	16	19 1/2	19	17		7 3/4	15 1/2					29 1/4	21						42	47	115 1/2
4	13 1/4	16	15 1/2	12 1/2	19	17 1/2	17 1/2		7 1/2	13 1/2					32	23						42	46	112
5	15	16	16 1/4	15	16	19	17		7	14 1/2					28 1/2	21						40	47	115 1/4
6	14 1/2	18	16	16 1/2	17 1/2	17 1/2	16 1/2		8 1/4	15					30	25						39	45	118 1/2
7	15	17	15 1/2	16	18	17 1/2	16		7	14 1/2					29	22						40	46	115
8	11	19	16 1/2	14	18 1/2	18	19									23 1/2					15 3/4	37	38 1/2	113
9	13	17	18 1/2	14	18	17 1/2	18 3/4		7 1/2	15 1/2					30 1/2	21 1/8					17 1/2	40 1/2	43	108
10	13	15 1/2	17 3/4	14 3/4	17 7/8	19	19		8 1/4	14					31 3/8	21 1/4					15 1/2	41	46	113 3/16
11	12	16	17	14 3/4	17 7/8	19	20		7 5/8	14 1/2					31 3/8	23 1/4					16	41	46	116
12	12 1/2	18	19 1/2	15	21	21	22		8 3/4	16						19 1/4					18 1/2	2 SEAT. 17.5	45	142
AVERAGE	13 3/16	16 1/2	16.8	14 9/16	18	18 3/16	17 15/16		7 13/16	14 5/8					30 1/2	22 1/2					16 1/4	39 7/8	45	113 15/16
*	12	17	17	14	19	19	19	7	8	15	18	4	37	38	30	24	17	9	5	4	17	40	47	

DIMENSIONS FOR "AVERAGE" DO NOT INCLUDE No. 12.

O = MINIMUM PRACTICAL
* = MINIMUM RECOMMENDED
} EACH DIMENSION IN THESE TWO LINES IS GIVEN AS AN INDIVIDUAL MINIMUM. COMBINATIONS OF SOME DIMENSIONS NOT FEASIBLE.

FIG. 1—DIMENSIONS THAT INFLUENCE THE DESIGN AND LOCATION OF SEATS

depends somewhat on the rake of the steering-column of course. The width of rear seats, as shown in the figures for 12 cars tabulated in Fig. 1, averages 45 in. for three passengers. It is preferable to provide, as nearly as is possible, a 16-in. cushion-space for each passenger.

Depth of Front and Rear Compartments

The distance between the front cushion and the dash, 30 in., usually is ample and does not vary to a great extent, as is shown in the tabulation of the dimensions of 12 different bodies in Fig. 1. The space provided between the rear cushion and the back of the front seat is determined by the use to which it is to be put. With the rear cushion in the compromise position recommended in the first part of this paper, the minimum distance should not be less than 21 in. If ample space for wearing apparel carried on the robe-rail or room for a traveling-case is desired, it will be necessary to increase this dimension, but 24 in. gives a comfortable compartment.

Knee-room to the front and rear of folding-seats in seven-passenger bodies or bodies having staggered seats should not be less than 26 in., measured from the back upholstery to the part of the structure in front. Therefore, allowing 1 in. for the thickness of the folding-seat back, the distance from the back upholstery of the stationary seat to the structure in front should not be less than 53 in.

Standardization of Control Dimensions

In conclusion, I wish to make another plea for the standardization of a range of locations for the control elements as outlined, and also to suggest that a manikin be developed to conform to the average dimensions of the human body, so that it can be used as a standard from which to work. If this accomplished nothing more than the discouraging of such proportions as are found in some of the bodies shown at one of the recent foreign shows, it would be well worthwhile.

DEOXIDATION OF STEEL

A THOROUGH study of the theory and practice of oxidation of steel was initiated by the National Research Council during the war. This important work has been continued under the direction of J. R. Cain, chairman of the Committee on Substitute Deoxidizers. This committee has issued a progress report, which will be followed by a more extended technical report, and extracts from the former follow.

One of the most difficult operations of steel metallurgy, called deoxidation, is that of removing from the molten metal before casting into ingots certain gaseous and solid foreign substances, known to the metallurgist as inclusions, that unavoidably enter the metal during the melting processes. Such foreign substances are present in varying amount and kind, no matter whether the steel is made in the Bessemer converter, the open-hearth furnace, in crucibles or in electric furnaces. The substantial removal of these substances or of their effects is fundamental and vital, because if ingots were cast from steel containing such inclusions they would be too brittle for the subsequent operations of rolling or forging, or would contain so great a proportion of blowholes as to be useless for most purposes.

Silicon, aluminum, manganese and titanium are the chemical elements that have been most used. These are generally employed in the form of their alloys with iron, except in the case of aluminum. Manganese is the most important of all the deoxidizing elements. In the present state of the art it is impossible to make steel that can be forged successfully or rolled without the use of manganese. It is the only one of the four elements mentioned that removes the fatal brittleness during hot-working that results from the presence of small amounts of sulphur that all steels contain. Without recourse to manganese the steel metallurgist would be forced to make steel almost free from sulphur to get a product useful in the arts; something well-nigh impossible with present-day high-sulphur fuels and steel scrap.

The committee has confined its experiments to 73 combinations of deoxidizing elements that exhibit characteristics worthy of further consideration. Methods had to be devised for making up the various mixtures and testing them under experimental conditions with a view to developing data and methods of procedure that could be subsequently applied to actual production conditions.

In devising methods for testing the efficiency of the deoxidizers a great amount of pioneer work has been necessary, for almost nothing had been done by others. The aim has been to study those functions of the deoxidizer that are deemed of most immediate interest to the steel manufacturers: (*a*) the greatest possible yield of sound ingots free from blowholes and with the minimum amount of shrinkage cavities; (*b*) the making of steel having satisfactory rolling and forging properties; (*c*) the production of metal free from iron oxide, slag or other solid inclusions; and (*d*) the fabrication of steel with the maximum freedom from dissolved gases.

Although actual tests of the alloys have only begun, there have been indications of very interesting results. For instance, some alloys have shown marked superiority in preventing segregation; others have given promise of replacing manganese to some extent in eliminating sulphur red-shortness. There has been opened up the possibility of refining the grain structure of steels by using special deoxidizers, and in many cases there is a great superiority in respect to the reduction of ingot loss from discards due to shrinkage cavities. As yet these are regarded only as indications of what can be expected, and for this reason no details as to particular alloys are justified at this time. However, it is hoped that the support for this work may soon make possible the full realization of these possibilities by those industries that can expect to be benefited.

The limited amount of work already done in testing the alloys has demonstrated that it will be possible not only to use less manganese alloy, whether of high or low percentage, but also to produce more or better steel by the use of the new alloys.

ENGINEERS IN PUBLIC DISCUSSION

FEW, if any, of our engineering institutions lay sufficient stress upon the importance of an engineer's ability to write correctly and to speak the English or any other language or to appear at ease before an audience. In consequence, thousands of otherwise capable engineers feel handicapped and make a bad impression when participating in public discussions. It is not sufficient that instruction along this line be given in the preparatory schools only, but should be accorded a very definite place, and its importance impressed upon the student throughout his college course.—F. D. Nash in *Engineering News-Record.*

Standards Committee Meeting

THE Standards Committee Meeting convened at 10:15 a. m., Tuesday, Jan. 10. Chairman B. B. Bachman spoke briefly on the procedure to be followed in the sessions in passing on the reports of the several Divisions.

The complete reports of the Divisions were published on pages 383 to 435 inclusive of the December 1921 issue of THE JOURNAL, and are those referred to hereinafter in connection with modifications that have been made in them, owing to typographical errors, changes directed by the Divisions after the reports were printed, or amendments at the Standards Committee, the Society or the Council meetings. The reports that were approved at these meetings are to be submitted to the Members of the Society for approval by letter ballot. This mail vote will be recorded at the offices of the Society on Saturday, March 11, that is 60 days after the Standards Committee meeting. The letter-ballot forms will be sent to the Members of the Society separately and should be returned on or before March 11 to be recorded.

AERONAUTIC DIVISION

(1) *Tachometer Drive*

[This report as printed on page 383 of the December JOURNAL was duly approved.]

THE DISCUSSION

H. M. CRANE:—The Aeronautic Division has again marked time as it was foreseen it would, partly due because the work done during the war rather outran the standardizing possibilities in the industry. This is exemplified in the case of the report presented today for revision of the standard for the Tachometer Drive. The tachometer drive was practically standardized in the original design without any notable amount of actual experience and proved to be too weak a construction for some of the large twin-engined machines in which long drive-shafts are required. In addition to this report of the Aeronautic Division, however, it should be noted that the Aeronautic Division is taking advantage of a large number of the Society's other standards. For instance, the report of the Iron and Steel Division applies practically as much to aircraft engine and plane standardization as it does to the construction of passenger cars.

BALL AND ROLLER BEARINGS DIVISION

(2) *Annular Ball Bearings*

[This report as printed on pages 383 and 384 was duly approved.]

THE DISCUSSION

F. W. GURNEY:—Last summer a complaint was made by one of the leading transmission manufacturers that the bore tolerances of ball bearings were not close enough. Aside from the automotive industries, especially among machine-tool builders, this complaint is much more insistent. After much consideration the Division finally agreed to revise the tolerances, which were previously from plus 0.002 in. to various minus values. The Division found that it is general practice to manufacture to plus zero, all the tolerances being minus.

CHAIN DIVISION

(3) *Roller-Chain Sprocket-Cutters*

[This report as printed on page 384 was duly approved.]

THE DISCUSSION

H. S. PIERCE:—The details of the cutters described in this report will be worked out and presented to the Society later on. At the Division meetings the general principles on which they will be designed were decided upon; and, as the standard tooth-form has been determined, it practically fixes the details. The use of straddle cutters is advantageous to manufacturers who do not produce a large number of any one size of wheel but have a number of miscellaneous sizes to make.

(4) *Roller Chains*

[This report as printed on pages 384 and 385 was duly approved.]

THE DISCUSSION

MR. PIERCE:—The formula and the table given in this report are recommended practice for the minimum breaking-strength of chains, and were developed by reason of a peculiar situation that has gradually developed in the industry. The only data that have been published generally on roller-chain strength refer to the ultimate strength and the general proportions. The ultimate strengths were, of course, for static test. They were also published generally as average strengths, which they actually are, but in cases of test, to increase the minimum ultimate-strength to be sure of passing the specification, certain elements in manufacture were showing a trend in the wrong direction. The ultimate strength of a roller chain can be increased by reducing the depth of the case on the pin, and by giving the pin a heat-treatment principally for the core, and increasing the carbon-content of the core. Actually, what is desired in roller chains is a high wearing quality and a great resistance to failure in service; dynamic strength rather than static strength.

The recommended values are slightly less than those generally published on ultimate strength, so that the efforts of the manufacturers can be directed toward really making better chains than to meet a nominal specification.

F. L. MORSE:—The point I wish to raise is that it is inadvisable to specify a minimum breaking-strength for publication, as this prevents in a certain measure the constant improvement that can be effected by the use of better grades of steel. Every manufacturer should have a free hand to increase the minimum breaking-strengths by such methods. This is well recognized as a means for improving production, where various grades of materials enter, and it seems to me that when a company uses the better grades of material, it should be permitted to receive the benefit of such increased cost as is reflected in the possible minimum breaking-strength.

M. C. HORINE:—This proposal was formulated by a joint committee of the American Society of Mechanical Engineers and this Society, and it was necessary to consider the application of roller chains in a rather broader field than that of the automotive industry. The result is that chains have been considered that have no automotive application, and I think that the minimum breaking-strength figures have been affected somewhat by the requirements of the general mechanical use of chains, which are not as severe as those in automotive applications, especially in truck and tractor drives. I believe that the proposed standard minimum breaking-strengths are too low, as the automotive industry is trying to get better, stronger chains all the time.

MR. PIERCE:—The ultimate strengths can be increased but it would be as a rule at the expense of elements that are really of much more value. If a chain comes up to the minimum ultimate-strength specified in the report and actually breaks in service under the static pull, it is really too light for the work.

The wearing quality of the chain depends on the character and the depth of the case on the pin. The deeper the case is, the less the ultimate strength is. If the pin is heat-treated to develop the best wearing qualities which is the element we really need, it is not heat-treated to bring out the maximum shearing strength also. In other words, the parts need a toughening treatment to get the best results. I think that every user of roller chains wants longer life.

If the only specification published is for a static test, conservative values will result in better chains, whereas higher values would tend toward improper design and manufacture. As better grades of material are developed, the values specified can be revised. But fairly high-grade materials, all good alloy-steels, are now used where chains have to stand the maximum work.

MR. CRANE:—Are these values supposed to indicate safe running loads on the chains on the order of what is used as safe running loads on ball bearings or roller bearings, or are they strengths to show on a testing machine whether the chain is up to specification?

MR. PIERCE:—These values are for tests on a static testing machine and are higher than any safe working load.

MR. CRANE:—I think that it is very desirable to state that clearly in this recommendation because so many standards of other kinds are used by engineers that the intent of this one might be mistaken.

C. N. DAWE:—Mr. Pierce said that the deeper the case is the less the ultimate strength is. Is he basing any opinion on that?

MR. PIERCE:—The chain pins are made of lower carbon-steel and the greater the depth of case is, the lower the shearing strength is. If the pins are given a heat-treatment for the case, it does not develop the maximum strength in the core. A tough pin is desired rather than just a hard one because an extremely hard pin is likely to fail under fatigue. Although these figures refer to a static test, the service is dynamic.

E. A. JOHNSTON:—It has been my experience that very few chains fail, and that failure is not always due to the shearing of a pin. In many cases it is caused by the bushing becoming loose in the side-bar. I have tested many chains with pins made of heat-treated alloy-steel. Specifying the minimum ultimate-strength will not prevent any chain-maker from advertising or stating that his chain has a much higher strength; that is simply a standard of measure to gage by. I believe also that the safe working strength of a chain, or the load on a chain, would be preferable to the ultimate breaking-strength.

MR. PIERCE:—It has been the practice of roller-chain manufacturers to publish not a minimum ultimate-strength, but an average. The natural variation in the material they get is a little below or above that average. This probably shows a factor that is a safety margin of 10 per cent, but there has been a tendency all along to derive a specification based on the strength of the chain, whereas it was not the strength of the chain that needed improvement; it was other elements at the expense of which strengths were being kept up. It would not be possible to recommend with safety working loads of chains, because the conditions under which they operate in the automotive industry alone, in the various applications, the speeds at which they run and the character of work require entirely different considerations.

F. W. ANDREW:—It seems to me that roller-chain users and the trade generally wish all the information contained in this report and I think that it should be approved.

MR. PIERCE:—We are trying to get some satisfactory engineering data on roller-chains with regard to working loads and the various other points for recommended practice, but our study has not yet been completed. This report is a step toward completing this work.

ELECTRICAL EQUIPMENT DIVISION

(5) *Insulated Cable*

[This report as printed on page 385 was duly approved.]

(6) *Starting-Motor Flange Mountings*

[This report as printed on page 385 was duly approved.]

(7) *Flexible Steel Conduit*

[This report as printed on pages 385-387 was duly approved.]

(8) *Non-Metallic Conduit*

[This report as printed on page 387 was duly approved with the exception that the minimum radius of ½ in. for bending, given in the last column of Table 5 and in the next to the last line of paragraph (5) was changed to 3 in.]

ENGINE DIVISION

(9) *Carbureter Flanges*

[This report as printed on page 388 was duly approved.]

(10) *Engine Numbers*

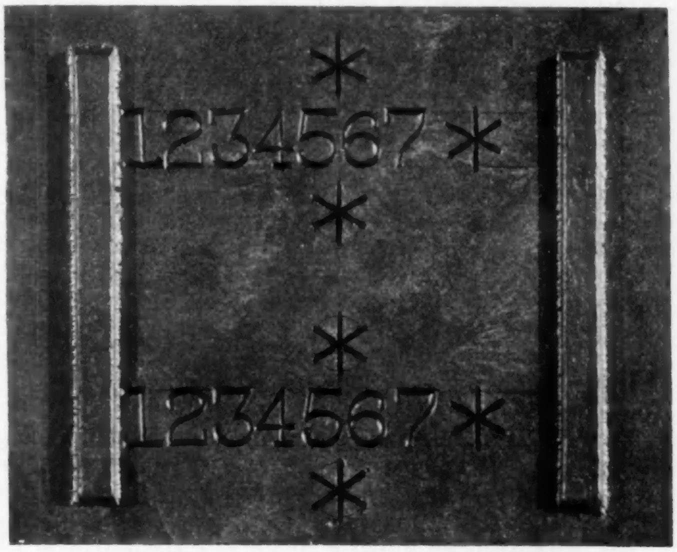
[This report as printed on pages 388 and 389 was by amending action duly approved for adoption as S. A. E. Recommended Practice as an alternative to the present S. A. E. Standard on page A13 of the S. A. E. HANDBOOK.]

THE DISCUSSION

MR. CRANE:—While I can see some difficulties in the method of numbering by casting the number directly on the crankcase, I would like to ask what difficulties the Division considered insuperable in connection with such a method in a factory building its own product. It seems to me to be probably the easiest thing to do in the long run. A crankcase might have to be scrapped from time to time, but there would be a complete record of the numbers, and it would simply result in the engine number of the last car put out being higher than the total number of cars. On the other hand, in the case of an engine builder producing engines for different car-makers, the procedure might lead to argument regarding the engine numbers. The engine builder would have to use serial numbers based on his production of engines, and this might not agree with what the car maker would want.

As far as effectiveness against altering numbers is concerned, it is one system that is certainly 100 per cent safe because it is absolutely impossible for any man stealing a car to alter or reproduce the number on a crankcase without practically reproducing the whole crankcase.

J. B. FISHER:—I agree with Mr. Crane that it would be ideal to cast the numbers on the crankcase and that the numbering could be controlled readily if the car builder were making engines for himself; but it is very difficult to control the numbers when making engines for several buyers. It is the desire of the Division to recommend a numbering system that will be used universally



Correct Method of Stamping Engine Numbers

by companies making their own engines and by companies who purchase from engine builders.

Mr. Crane:—Would the Division object to having more than one system? It seems to me that the casting system has such simplicity compared to the system recommended that there is no reason why the Society should not recommend it to companies that are in a position to use it. It should be the preferred method, I think. The other should be the method where it is necessary to have a more flexible system of numbering for one reason or another than can be obtained by the cast numbers.

Mr. Fisher:—I think there would be no objection to having an optional system.

A. J. Scaife:—I would like to inquire whether the Underwriters Laboratories has approved this method and, if not, whether it is advisable to accept it as a standard. When we first considered this subject there was discussion of this method and it seemed advisable for us to recommend a method that would be approved by the Laboratories before we adopted it.

Mr. Fisher:—A set of sample plates was made up and forwarded to the Underwriters Laboratories at Chicago. It has not submitted its report to us yet.

R. S. Burnett:—Mr. Small, vice-president of the Underwriters Laboratories, has stated that this recommendation looks as promising as anything that had been brought to light so far. We are awaiting advices from the laboratories as to the result of testing this method of numbering engines.

W. S. Haggott:—I do not know that it is necessary to get the underwriters' approval on a matter of this kind. If it is a good thing, the Society could adopt it anyway.

Mr. Horine:—With reference to Mr. Crane's remarks on casting the number on the crankcase, I would say that a proposal was made some time ago for a checkerboard system, specifying digits from 0 to 9 in vertical columns and a sufficient number of columns to make up the number of digits in the number. The actual number would be shown by drilling out all digits not wanted in each row. That, it seems to me, would be utterly impossible to change, although it would not provide for error any more than the straight casting method. It would, however, make it impossible for a thief to grind down the surface of the casting and restamp a new number, which can be done where the number is merely stamped in the crankcase, as is now the practice.

Mr. Fisher:—That proposal was made at the Division meetings. The objections to it were the large amount of drilling necessary to get the number on each crankcase and that it would be possible to drill out one or more of these numbers and insert plugs of the same metal with different numbers on them. A competent mechanic could do that in a way that would be very hard to detect. We are aiming at simplicity above everything else, and trying to get an effective method that can be used with the least work and expense in the foundry and in the shop.

Chairman Bachman:—The Division has considered the question of numbering engines in such a manner that the marking cannot be altered by an unauthorized person. The desirability of such a system is self-evident. A number of ideas have been submitted; among them the ones that Mr. Crane and Mr. Horine have indicated. The Division has recommended a method that in its opinion is possible and simple, but, as has been pointed out, the benefits of adopting such a system are dependent in part at least upon its acceptance by the Underwriters Laboratories. It may be desirable for us to proceed along our own lines, standardizing what we conceive to be good, or to await the approval of other organizations before we take action. It may be possible to have two acceptable systems; one that would be used by those making their own engines and another for use under different conditions.

Mr. Burnett:—This proposal is in the form of a revision of an S. A. E. Standard that has been in The Handbook for a number of years. The present standard specifies the stamping of numbers at least $\frac{1}{4}$ in. high. That is as far as it goes.

Mr. Crane:—The proposal is for a safety system of numbering. The other was simply a system of numbering without any regard to its safety.

A. K. Brumbaugh:—Even after stamping the numbers on the rough surface of the casting and between the rough parallels, it is possible to cut out the numbers and sandblast that part of the casting so that in a very short time afterward it will have the same appearance as the original surface with the new or false numbers stamped in. Approval of this recommendation, even as a recommended practice, means a change of patterns and possibly foundry methods that would be justified only by having something that is final and acceptable to the insurance authorities.

Unacceptable Method of Stamping Engine Numbers

(11) *Fan Belts and Pulleys*

[This report as printed on pages 389 and 390 was duly approved with the exception that in Tables 6 and 7 the term "inclusive" should apply to the column of "Maximum Fan Diameters."]

THE DISCUSSION

W. L. GILMER:—Standardization of fan belts and pulleys is really necessary. At present very little has been done following such standards as have been set. The majority of the fans on automobiles are from 15 to 18 in. in diameter and of 1⅞-in. or less projected blade-width. The belt widths range from ⅝ to 1½ in. These recommendations seem to be based entirely on fan diameter and projected blade-path, while they should be based on the power requirements of the fan, the fan diameter and speed, the projected blade-path and the size of pulleys. For instance, a 1¼-in. belt with a 15-in. fan of 1⅜-in. blade-width traveling at 200 r.p.m. will require about 1/16 hp. An 18-in. fan of 1⅞-in. blade-width will take 1.8 hp at the same speed. If the speed is increased, the power required at the belt is considerably larger. Both of those fans do not require the same width of belt. It would be very much better if the pulley and belt widths were specified according to the power that is required with them.

As large pulleys as possible should be used so as to get higher belt speeds, lower initial belt-tension and greater belt contact on the pulleys. It is a mistake to crown both pulleys. In assembling an automobile it is almost impossible to get the peak of the crown on both pulleys in perfect alignment, and if the pulleys are not in alignment, they will force the belt to travel crookedly or weave, resulting in the belt binding on the flange and jumping off the pulley. The crown should be on the driving pulley only; not on the fan pulley. A crown of 1/16 in. on the fan pulley will reduce the power-transmitting capacity of the belt from 10 to 15 per cent. The crown recommended will average about 1/16 in. and in many applications will allow the belt to be considerably overloaded. The fan pulley is usually smaller than the driving pulley and consequently has less belt contact. If this belt contact is further reduced by crowning it, the belt capacity will be reduced to an extent that will be troublesome.

G. A. BARNARD:—I subscribe heartily to everything that Mr. Gilmer has said. He called attention to the fact that fan-belt and pulley requirements are based on horsepower. I think that this recommendation is a step far in advance of what has ever been done. I think it should be accepted, but there is still the need for a tremendous amount of investigation along the lines suggested by Mr. Gilmer to determine the horsepower ratings of fans and also of generators and pumps. Very few manufacturers appreciate how tremendously the horsepower requirements increase with slight increases in fan speed. Referring to Fig. 2, I suggest that the terms referring to the V-belt pulley "For power drives" and "For fan drives," be clarified. I would like to inquire why the 38-deg. angle is recommended for the V-belt on the fan drive.

MR. FISHER:—The expression "For fan drives" refers to applications in which only the fan is driven. The expression "For power drives" includes applications in which also the generator or the pump is driven off the same belt. The two angles were selected after a careful study of those in general use. It seemed to the Division that they are about the best that can be recommended. Permitting the belt to slip more readily at high speeds was one of the factors that affected the selection of these angles.

I am sorry that Mr. Schwitzer of the Automotive Parts Co. is unable to be here today, as he was Chairman of the Subdivision that investigated this subject very carefully and prepared a comprehensive report on it.

I would like to state that determining the fan horsepower by the projected width of the blades is not a very satisfactory method. We have found that a fan-blade of 2¼-in. projected width may take less horsepower than a fan of the same diameter having only 1⅞-in. projected width, because much depends upon the angle of the blades and the type of bearing in the fan. It is difficult to determine the horsepower required from the diameter of the fan and the projected width of the blade.

CHAIRMAN BACHMAN:—There is, undoubtedly, room for difference of opinion on this subject, but the probabilities are that this work will be expanded and continued.

MR. BARNARD:—I am not opposed to the approval of this recommendation. I am heartily in favor of it.

F. G. WHITTINGTON:—Was the consideration of this subject based on two, three, four, five or six-blade fans? A 20-blade fan would reduce the required horsepower to practically nothing. Most of our work has been done with the conventional four-blade fans.

MR. FISHER:—I believe this recommendation is based largely on conventional four-blade practice, but most of it will undoubtedly apply to other fans.

(12) *Mufflers*

[This report as printed on page 391 was duly approved.]

THE DISCUSSION

RALPH MURPHY:—We believe that in many cases a smaller muffler will be satisfactory. We also believe that a smaller pipe and tail-pipe would be satisfactory with a smaller muffler. We suggest a muffler 5 in. in diameter with a volume of approximately 350 cu. in. and a tail-pipe of 1¼-in. diameter.

MR. HORINE:—The standard proposed does not include the larger sizes for trucks and particularly for tractors. The motor truck and the automobile are pretty closely allied and it seems to me that this recommendation might very well be extended to include 4-in. exhaust-pipes.

There is also some difference of opinion as to whether the tail-pipe should be smaller than the exhaust-pipe. Some manufacturers make the tail-pipe larger than the exhaust-pipe on the principle of slowing-down the flow of the exhaust gas instead of speeding it up. It would not seem to be any violation of the principles of standardization to provide some option on the tail-pipe size, so that a manufacturer could use a larger tail-pipe, if he wished to.

If it is not desired to extend the sizes of exhaust-pipe to include heavy trucks, the recommendation should be specified as a passenger-car and not a motor-truck standard.

MR. FISHER: The Division felt that the 3-in. diameter exhaust-pipe is larger than most of those in general passenger-car and truck practice.

MR. HORINE:—We use a 4-in. size.

MR. FISHER:—Your company is one of the few that uses so large a size. It was felt that anyone using a pipe that large would naturally install a special muffler in connection with it. For instance, the muffler 7 in. in diameter and 28 in. long is a pretty good-sized muffler

and will, I think, meet nearly all the requirements of truck service. There is nothing however to prevent standardizing the larger sizes if it is felt generally that this should be done.

Frames Division

(13) *Running-Board Brackets*

[This report as printed on pages 391 and 392 was duly approved].

Iron and Steel Division

(14) *Iron and Steel Specifications*

[The following changes and corrections were made in the report at the meeting of the Iron and Steel Division held Jan. 9, and approved at the Standards Committee and Society meetings.]

Page 397, Part VI, Definitions.—The definitions for "Normalizing" and "Annealing" should begin "A uniform heating above the . . . . "

Under Fig. 12 add equation

"Gage Length $d = 4.5 \sqrt{}$ Area of Cross-Section"

Under the heading "Construction," third paragraph, last sentence, delete "Plain ends for grips" and "may be used" and add "are recommended."

In the fifth paragraph, seventh line, delete "equals 4½ times the square root of the area" and substitute "conforms to the formula

"Gage Length $d = 4.5 \sqrt{}$ Area of Cross-Section"

In the fifth paragraph, lines 12 and 13, delete "Plain ends for grips" and "may be used" and substitute "are recommended."

Page 398—Delete Fig. 13 and the accompanying table. The last sentence of the first paragraph in the first column should read "Threaded or self-aligning ball-ends are recommended." Delete the entire third paragraph in the first column.

Page 399—Under the heading "Case-Hardening," second paragraph, delete "process of" and substitute "procedure after."

Page 400—Under "S.A.E. Steels 1010 and 1015," first paragraph, first line, delete "seamless." In the fifth paragraph, eighth line, change "strength" to "refinement" and in the last line change "core" to "case."

The following corrections were made in Brinell and Shore Hardness values.

Page	*Steel*	*Quench*	*Drawing Temperature, deg. fahr.*	*Hardness Numbers Brinell*	*Shore*
401	1020	Water	600	...	28
			900	...	27
	1025	Water	400	192	..
			600	192	..
402	1035	Oil	800	197	32
			900	192	31
			1000	187	31
			1100	183	30
			1200	179	30
			1300	170	29
	1035	Water	1200	183	..
			1300	174	..
403	1045	Oil	800	235	37
			900	...	36
			1000	223	34
			1100	212	33
			1200	207	33
			1300	192	31
	1045	Water	1000	229	..
			1200	212	..
			1300	197	32
409	3120	Oil	800	241	..
			900	217	..
			1000	201	..
			1100	187	..
			1200	170	..
			1300	163	..
410	3130	Oil	800	...	44
			1000	...	37
			1100	...	33
			1200	...	31
			1300	...	29
411	3140	Oil	800	...	49
			900	...	45
			1000	269	41
			1100	...	38
			1200	...	35
			1300	...	33

Page 411—The curves of physical properties for Steel 3140 quenched in oil, shown in Fig. 29, should be replotted to the following points.

TABLE FOR STANDARDS COMMITTEE MEETING

Drawing Temperature, deg. Fahr.	Thousand Pounds per Square Inch			
	TS	YP	Red	Elon
800	176	152	44	11
900	156	132	50	16
1000	138	115	55	18
1100	124	99	58	19
1200	111	85	62	20
1300	102	70	64	20

Page 422—Heat-treament 9250-VIII and 9260-VIII, operation 6 should read "Quench in oil."

[With the corrections indicated above this report as printed on pages 392 to 422 was duly approved.]

THE DISCUSSION

F. P. Gilligan:—With reference to the reservation of the number 4 for molybdenum steels, the Division has taken no action toward standardizing molybdenum steel specifications but, feeling that it has to take into consideration the fact that this type of steel is being used and that it may be proposed as a standard S.A.E. steel in the future, considers it advisable to reserve number 4 for that type of steel to the end that those who are working with it can classify it by the same symbol.

Part II of the Iron and Steel Division Report, appearing on page 394 of the December Journal, and entitled Specifications for Automotive Steels, is an existing standard conforming to that of the American Society for Testing Materials and has only been brought uptodate, no important changes having been made in it.

In part III, Chemical Compositions, there have been added steels 1015, 1030, 1040, 1046 and 1050. Steel 1015 is a carburizing type. Steel 1046 is primarily a carbon gear-steel; and 1030 and 1050 were added at the request of the American Gear Manufacturers' Association. No change is made in the screw stocks, steel castings or nickel steels. The manganese range on 2315, a carburizing type, has been lowered from 0.50-0.80 per cent to 0.30-0.60 per cent and nickel steel 2350 has been added at the instance of the American Gear Manufacturers' Association.

In the nickel-chromium series a 0.15-per cent carbon low nickel-chromium steel, 3115, has been added for carburizing purposes; it is a better carburizing steel than 3120.

Likewise a 0.15-per cent carbon steel, 3215, has been added and also steel 3245, midway between the 0.40 and 0.50-per cent carbon ranges to give a little closer range for certain gear requirements. Steel 3312 is proposed as a carburizing type for the 3300 series. The carbon ranges of steels 3320 and 3330 have been raised five points, changing them to steels 3325 and 3335, these ranges apparently reflecting general usage.

In the chromium steels, 5165 has been deleted, as there is apparently no use for it, and 5150 has been added for shafting material and for gear purposes. These constitute the only changes, most of them being additions to the present S.A.E. standard compositions.

Part IV, Steel Castings, is a copy of what has heretofore prevailed. No change is proposed in this specification.

Part V, Malleable Iron Castings, is a copy of what has prevailed in the past and is the same as the specification of the American Society for Testing Materials.

In proposing Part VI, Definitions, the Division recognizes the fact that it is difficult to get agreement on definitions pertaining to metallurgy. The definitions are proposed with distinct reference to their use in these specifications and not with reference to their general application.

Lighting Division

(15) *Bases, Sockets and Connectors*

[This report as printed on pages 422 and 423 was duly approved.]

(16) *Lamp Glasses*

[This report as printed on page 423 was duly approved.]

(17) *Tail-Lamps*

[This report as printed on page 423 was duly approved.]

Non-Ferrous Metals Division

(18) *Solders, Specifications, Nos.* 1, 2, 3 *and* 4

[In specification No. 1, Class B, the limits for tin should be 48.76 to 49.74 per cent. In Specification No. 2 the limits for tin in Class A should be 44.55 to 45.45 per cent and in Class B, 43.07 to 43.93 per cent. In Specification No. 3, Class B, the limits for tin should be 37.62 to 38.38 per cent.]

[With the corrections indicated above these specifications as printed on pages 423 and 424 were duly approved.]

THE DISCUSSION

Mr. Mougey:—These specifications cover four grades of solder. Specifications Nos. 1, 2 and 3 are the same as American Society for Testing Materials specification No. B32-21. These specifications were printed in the form used in the S.A.E. Handbook which gives the ranges as maxima and minima. The American Society for Testing Materials specification gives the range in tin as 1 per cent plus or minus of the content specified. The two methods of calculating the tin range will have a very small effect in the limits permitted, but the Division has decided to recommend that, instead of having specifications 1, 2 and 3 given with the limits as printed, the limits as calculated by the American Society for Testing Materials method be adopted. This will change the limits somewhat in some cases.

Specification No. 4 does not appear in the American Society for Testing Materials specifications since the lowest tin-content in those solders is 33 per cent. The limits for composition in specification No. 4 cover, it is thought, the same range as the American Society for Testing Materials would have covered if it had a similar solder specification.

(19) *Babbitt, Specification No.* 14

[After deleting the reference to iron in the table of composition the specification as printed on page 424 was duly approved.]

THE DISCUSSION

Mr. Mougey:—Subsequent to a request from the Stationary Engine Division for a babbitt having a composition of approximately 70 per cent lead, 15 per cent tin and 15 per cent antimony, several babbitts were obtained from stationary-engine sources and analyzed. They were found to agree closely with American Society for Testing Materials specification No. B23-18-T, and the Division has offered Specification No. 14 tc meet the request of the Stationary Engine Division.

(20) *Manganese Bronze, Specification No.* 43

[This specification as printed on page 424 was duly approved.]

THE DISCUSSION

Mr. Mougey:—This specification as it is now printed in the S.A.E. Handbook gives no satisfactory way of inspecting the bronze. The proposed physical test is the same as that of the American Society for Testing Materials, specifying the same tensile-strength and elongation requirements and the same preparation of test-bars. In the second paragraph, third line, of the specification, the expression "½-in. test-bar" should be changed to "standard S.A.E. test-bar," since there is a slight discrepancy between the standard S.A.E. test-bar and the American Society for Testing Materials test-bar. The difference is exceedingly small but the S.A.E. standard should be consistent with itself in these specifications.

(21) *Cast Brass To Be Brazed, Specification No.* 44

[This specification as printed on page 424 was duly approved.]

THE DISCUSSION

Mr. Mougey:—Specification No. 44 covers cast brass to be brazed. This is a composition for which there is a demand at times, and the specification covers one of the most desirable compositions for this kind of material.

(22) *Brazing Solder, Specification No.* 45

[This specification as printed on pages 424 and 425 was duly approved.]

THE DISCUSSION

Mr. Mougey:—Brazing solder is the material used in dip-brazing or in several other varieties of brazing as mentioned in the note on General Information. This specification covers a material that is common in the industry.

(23) *Commercial Sheet Brass, Specification No.* 70

[This specification as printed on page 425 was duly approved.]

THE DISCUSSION

W. B. Price:—This is a revision. We have simply changed the table of permissible variations in thickness to conform to those of American Society for Testing Materials specification No. B36-21.

(24) *Copper Sheet, Specification No.* 71

[This specification as printed on page 425 was duly approved with the addition of the following note under the table of "Permissible Variations in Thickness."]

These should be considered as general specifications.

Since copper sheet is used for many purposes where the requirements of the operations used are too particular to be specified by any of the ordinary physical tests, it is frequently advisable to submit samples or drawings to the manufacturer and secure an adjustment of anneal or temper to suit the actual operations to which the material is to be subjected.

THE DISCUSSION

MR. PRICE:—This report is a revision of the table of ultimate strengths and elongations to replace that now printed in the S.A.E. HANDBOOK.

MR. GILLIGAN:—I would like to inquire what form of test is recommended for copper from 0.005 to 0.031 in. thick. The reason I raise the question is that we are confronted with a similar condition in the case of sheet steel and I was wondering if the sheet brass and sheet copper manufacturers have a satisfactory test-specimen for this thin sheet.

MR. PRICE:—We would use a section about ½ in. wide with about 2 in. between the punch-points. There should be a note, similar to the one appended to specification No. 70, stating that not very reliable results can be had on such thin material.

F. G. SMITH:—The recommended limits for tensile-strength are set, I believe, at such figures that if thin pieces having an average width of ½ in. and a 2-in. gage-length are tested and care is taken to see that they are straight so as not to tear, they will meet these specifications.

MR. PRICE:—We have not been able to develop anything that gives us more satisfactory results, so these figures have been set low enough to meet the requirements of test.

MR. MOUGEY:—We have made a great number of tests on thin sheets and find that the main trouble is in trying to test the small specimens in large testing-machines. The small test-specimens should be tested in a smaller machine to get a straight pull.

(25) *Naval Brass (Tobin Bronze) Rod, Specification No.* 73

[This specification as printed on pages 425 and 426 was duly approved. The discussion of this specification will be found with that of Specification No. 76 for Naval Brass (Tobin Bronze) Tubing.]

(26) *Naval Brass (Tobin Bronze) Tubing, Specification No.* 76

[This specification as printed on page 426 was duly approved.]

THE DISCUSSION

MR. PRICE:—Specification No. 73 is only a revision as a result of the insertion of "Tobin Bronze" in parenthesis, because this material is widely known by this name. Specification No. 76 is new and is submitted by the Division for adoption as S.A.E. Standard.

(27) *Brass Spring Wire, Specification No.* 80

[This specification as printed on page 426 was duly approved. The discussion of this specification will be found with that on Specification No. 88 for Brass Forging Rod.]

(28) *Phosphor-Bronze Spring Wire, Specification No.* 81

[This specification as printed on page 426 was duly approved. The discussion of this specification will be found with that on Specification No. 88 for Brass Forging Rod.]

(29) *Brass Forging Rod, Specification No.* 88

[This specification as printed on pages 426 and 427 was duly approved.]

THE DISCUSSION

MR. PRICE:—Specification No. 80 is a new one covering Brass Spring Wire; Specification No. 81 is new and covers Phosphor-Bronze Spring Wire. Specification No. 88 also is new; it conforms with Specification No. B15-18 of the American Society for Testing Materials.

PARTS AND FITTINGS DIVISION

(30) *Rod-Ends*

[This report as printed on page 427 was duly approved.]

THE DISCUSSION

F. G. WHITTINGTON:—The proposed revision of the S.A.E. Standard on Rod-Ends involves nothing other than adding the yoke-end boss diameters to the present standard on page C-8 of the S.A.E. HANDBOOK. These dimensions were decided upon in cooperation with the manufacturers of rod-ends and with car builders who make rod-ends. The Division found only two of the latter who deviated from the standard rod-ends. Both of them have now agreed to conform to the general practice.

The change in dimension K for the ⅞-in. size is made to correct an error in the original printing of the standard several years ago.

(31) *Taper Fittings for Plain and Slotted Nuts*

[This report as printed on page 427 was duly approved.]

(32) *Water-Pipe Flanges*

[This report as printed on page 427 was duly approved.]

(33) *Lock Washers*

[In Table 15 on page 429 the dimension *B* for the ¼-in. S.A.E. Standard Bolt was changed to 7/16-in. to correct a typographical error. With this correction the report as printed on pages 428 and 429 was duly approved.]

THE DISCUSSION

MR. WHITTINGTON:—The lock-washers recommended in revision of the present standard on page C5 of the S.A.E. HANDBOOK have been under discussion for a considerable length of time, the Motorcycle Division having brought up the question of the weights of washers for use against aluminum, and alleging that some of the washers are entirely too heavy for good practice. This recommendation also reduces the number of sizes by about one-third.

PASSENGER-CAR BODY DIVISION

(34) *Passenger-Car Door-Handles*

[This report as printed on page 428 was duly approved.]

(35) *Passenger-Car Doors*

[This report as printed on page 428 was duly approved.]

(36) *Rubber Bushings*

[This report as printed on page 428 was duly approved.]

(37) *Wiring for Beads*

[This report as printed on page 428 was duly approved.]

(38) *Body Nomenclature*

[At a meeting of the Passenger-Car Body Division, held Jan 9 the illustration and description for Fig. 51, and the brief description of this body in the Landaulet type, printed below Fig. 57 on page 431 of the Decem-

ber JOURNAL, were deleted from the Division's recommendation.

With the changes indicated above the report as printed on pages 430-432 was duly approved.]

THE DISCUSSION

E. G. BUDD:—This recommendation is in the nature of a revision of the present more or less obsolete nomenclature in the S.A.E. HANDBOOK, and is intended to bring about uniformity in nomenclature.

H. W. SLAUSON:—Should not Fig. 51 be entitled "close-coupled sedan" and retained as a distinctive type of body?

MR. BUDD:—It was the Division's thought that the builders will use various prefixes to describe that type. One will call it a "four-door coupe-sedan"; another a "close-coupled sedan."

SCREW-THREADS DIVISION

(39) *Pressure-Gage Connections*

[This report as printed on page 432 was duly approved.]

THE DISCUSSION

EARLE BUCKINGHAM:—The Division tried first to formulate one single standard but found that it would not meet the needs of the trade. Three sizes, including one alternate construction for the 1/8-in. standard taper pipe-thread are proposed. The pipe-thread size is intended for motorboat applications principally.

ALEX. TAUB:—The S.A.E. flared tubing connection is I think becoming antiquated and should be reconsidered. This recommendation is of no earthly use to us because we do not use this kind of a connection.

MR. BUCKINGHAM:—This recommendation is intended to cover all general applications; the 1/8-in. taper pipe-thread is to be used where the flared tube union connection is not desired. Provision can be made easily for tapping special gages to the standard 1/8-in. tapped hole.

MR. TAUB:—That would raise the cost to us about 60 per cent. We would rather design the tapped hole in the gage to fit the coupling and save that cost. We are doing it in other units and would want to do the same with the gages.

MR. BURNETT:—This recommendation has been considered by the gage manufacturers and, as it met with their approval, it evidently covers the requirements of the bulk of their production.

MR. CRANE:—I think that this report should be approved inasmuch as this flared-type connection is already an S.A.E. Standard. Personally I do not like it as well as the soldered union.

MR. BURNETT:—This report can be accepted and the subject considered again by the Division with the view perhaps of including the other type of connection referred to by Mr. Taub.

MR. BUCKINGHAM: — When the Division considered this subject as much information as possible was secured as to the various types of connections used. Practically all that I saw embodied the S.A.E. flared-union connection.

TRACTOR DIVISION

(40) *Tractor Drawbar Height*

[This report as printed on page 433 was duly approved, with the subject changed to "Tractor Drawbars" and the caption of Table 18 changed to "Tractor Drawbar Adjustments."]

TRANSMISSION DIVISION

(41) *Transmission Tire-Pump Mounting* (p. 433)

[This report as printed on page 433 was duly approved.]

(42) *Clutch Facings*

[This report as printed on pages 433 and 434 was duly approved.]

TRUCK DIVISION

(43) *Three-Joint Propeller-Shafts*

[This report as printed on pages 434 and 435 was duly approved.]

UNACCEPTED RECOMMENDATIONS

ELECTRICAL EQUIPMENT DIVISION

Generator Flange Mounting

[This report as printed on page 385 was referred back to the Division for further consideration particularly with reference to shaft diameters.]

THE DISCUSSION

MR. ANDREW:—The proposed change is intended to provide one armature shaft-end that can be used on both sizes of generator, which it seems desirable to be able to do.

R. G. THOMPSON:—Some engine builders use a No. 1 generator size and some a No. 2; they have practically the same work to do. Heretofore the standard called for one shaft-end for the No. 1 flange and a different shaft-end for the No. 2, so that in building a generator, one that would otherwise be the same, except for the flanges, there are two different types of armature shaft-ends. This recommendation is to make the armature-shaft extension the same for the No. 1 and the No. 2 S.A.E. Standard flange. Another feature of the recommendation is the provision for a washer, which is not included in the present standard. There is also a minor change in the location of the cotter-pin hole, so that it will not offset the drill center in the shaft-end.

C. MARCUS:—As I understand this recommendation it refers to changing the length of the threaded portion of the armature shafts to include a washer between the pinion or sprocket and the clamping nut. The threaded portion of the shafts is of the same length as in the present standard but is now made so that a washer can be included.

There is a larger diameter of shaft in the No. 2 flange, requiring a 204 size bearing, if ball bearings are used, instead of a 203. That is, if the bearing be the 203 in the No. 1 flange, it will have to be changed to the 204 and we will be standardizing a larger and more expensive bearing than the smaller flange would warrant. I think that is not intended.

CHAIRMAN B. B. BACHMAN:—There is 1/8-in. difference in the diameter of the shafts and the proposed change in the length will not accomplish the interchangeability desired as indicated by the discussion.

MR. CRANE:—As I understand it, this is a proposal to permit of putting a small flange on a large generator and a large flange on a small generator. If that is so, this revision will undoubtedly make it somewhat simpler for the manufacturer, even if the shaft diameters are different. Nothing would be different then except the pinion, which would be supplied by the maker himself who desired such an unusual combination of generator and flange sizes.

MR. MARCUS:—If that is the purpose of the change, there would not be anything against it except that it would be an unusual case. If it were desired to use ball bearings, let us say, in the case of the large flange with the small generator and small armature, there would have to be additional operations on the large flange

that would then become non-standard for the smaller bearing. That would cause additional working difficulty and overbalance the good effect to be obtained by taking care of what I think is a hybrid case.

MR. THOMPSON:—If it were possible to amend the report now to provide for a ¾-in. diameter shaft for both the shaft extensions, we would like to see it done. If that is not possible here, I suggest that we refer the matter back to the Division.

ENGINE DIVISION

Engine Testing Forms

[On page 391 of the December JOURNAL under "Specification Sheet B" the second paragraph should read "Under item No. 32, Lubricating System, Type and Description, provide for recording Cold Test and the Saybolt viscosity at 150 and 350 deg. fahr." Under "Log sheet C," the formula should read

$$B.Hp_c = B.Hp_o \times (P_s/P_o) \times (T_o/T_s)$$

and in the key to abbreviations, the words "of mercury" following "$B.Hp_o$" should be omitted.

With the corrections indicated above this report as printed on pages 390 and 391 was approved by the Standards Committee but was referred back, at the Society meeting, to the Engine Division for further consideration with relation to the temperatures specified for Saybolt viscosity.]

THE DISCUSSION

MR. FISHER:—The original intention of the Division was to revise the S.A.E. Engine Testing Forms so that the same forms could be used in testing practically all types of internal-combustion engine but it was soon found that this was not practicable, and therefore only a few minor changes in our present forms are now recommended.

In connection with specifying 350 deg. fahr. for the viscosity test it was assumed that this represents approximately the temperature of the cylinder wall and the sole object in including it in the form is to enable engine builders to make intelligent comparisons of the same engine on tests conducted in different laboratories or at different times. The viscosity of the oil is a considerable factor in determining the friction horsepower of the engine and thus it is a factor in determining the brake horsepower. The 150-deg. fahr. temperature was taken as a fair temperature for crankcases, particularly for heavy-duty engines, and is intended for the same purpose as the 350-deg. record.

A. C. BROWN:—The Bureau of Standards recommends that no other temperatures should be used than 100, 130, and 210 deg. fahr., as adopted by the Committee on the Standardization of Petroleum Specifications and the American Society for Testing Materials. The proposed temperature of 350 deg. is especially undesirable because at this temperature, using the Saybolt Universal viscosimeter, all oils would appear to have practically the same viscosity.

MR. FISHER:—That point was considered by the Division. It seemed to be the consensus of opinion that 150 deg. is nearer the crankcase temperature than 130 deg., particularly in the heavy-duty engines. I know from experience that it is not uncommon in the heavy-duty engines to find the crankcase temperature as high as 180 deg. In passenger-car engines a temperature of about 130 deg. is reached in the actual operating conditions.

P. J. DASEY:—The temperatures recommended are the ones at which the engines operate under maximum working conditions, and it seems to me that we should have some point at which the viscosity should be determined for these working temperatures. I feel that the temperatures of 100, 130, and 210 deg. fahr. were set at a time when they were considered for the lubrication of other than internal-combustion engines, and that they do not mean very much to us in our engine practice unless we have some means of checking the viscosities under conditions more nearly approaching those under which we operate.

If we can get a value at the working temperature, or something approximating it, we will be able to make direct comparisons of our data at operating conditions.

MR. MOUGEY:—It is my understanding that the National Petroleum Association has agreed to follow the American Society for Testing Materials in the matter of specifications for oil. There has been a big difference of opinion on oils and methods of testing them and I think it is very desirable to have the methods as nearly standard as possible. The oil that is used in the engine is not, of course, the original oil put into the engine because of crankcase dilution, which changes the viscosity considerably, especially on the cylinder walls where the dilution is high. This viscosity may be related in no way to the viscosity of the original oil. For that reason it seems to me that a standard method of describing the oil, such as that of the American Society for Testing Materials, is preferable to a method that tries to meet engine conditions that are not and perhaps cannot be known.

MR. DASEY:—There is a very large difference in oils of different bases. We all know that asphaltic-base oils are very much more viscous than paraffine-base oils when cold, but at high temperatures they are not as viscous as paraffine-base oils. Unless we have a range of viscosity figures that will show the decrease of viscosity of the different grades of oil, we are not in position to make a proper selection of oils. While it is true that there is considerable dilution in the application, depending upon the type of engine, the manifolds and other factors, it seems logical that we should have some fixed method of determining the value of the oil under operating conditions.

CHAIRMAN BACHMAN:—While it is true that other organizations have outlined specifications dealing with the determination of viscosity of oils, the Division has had something else in mind. Mr. Fisher summed up the matter rather clearly when he said that the purpose in putting this information on the testing forms is to provide for recording engine-testing data that will permit of directly comparing engine tests. Whether this will accomplish the desired results may be open to a difference of opinion.

MR. CRANE:—It is proposed to measure the viscosity at 350 deg. fahr. as representing somewhere near operating engine temperatures. The measurement of viscosity at this temperature is very difficult and uncertain, and I am convinced from my own experience and that of oil men that viscosity measured at 100, 130, and 210 deg. fahr., which are the present standard temperatures, will accomplish the same purpose. There is very little use of putting something on the engine test sheets and encouraging some of our members to think it is a feasible measure if we know very well that it is not.

PROGRESS REPORT

TIRE AND RIM DIVISION

Pneumatic Tires and Rims

[This report as printed on pages 432 and 433 was presented and considered as one of progress only.]

THE DISCUSSION

J. G. VINCENT:—I wish to make a statement about the Tire and Rim Division report, because it has been before us for some time, and we have not made apparently the progress we should have made. This matter came up very definitely at a Summer Meeting of the Society at Ottawa Beach.

At that time some of the members of the Rubber Association of America had in mind some rather radical revisions of the tire standards and to find out quickly what the consensus of opinion was among the tire manufacturers, I took it upon myself to write the presidents of the various tire companies. This eventually resulted in the meeting in Cleveland in November, 1920, at which the matter was thoroughly discussed. It was made very clear at that time that radical revision of the pneumatic-tire standards was not wanted. It was, however, recommended at that meeting that a committee be appointed by the Society, with members representing the Society, the Rubber Association and the National Automobile Chamber of Commerce, to study this matter from various points of view, engineering, economic and commercial.

A committee was duly appointed, consisting of H. M. Crane and myself, representing the Society; Mr. Viles, of the Rubber Association, and H. H. Rice, of the National Automobile Chamber of Commerce. After going into the subject carefully, it became clear to us that what was wanted, and the only practical thing that could be accomplished at the time, was to revise the S.A.E. Standards in a very modest way. We prepared a report and submitted it to the Rubber Association, and after making a few suggested changes, it was approved. We were assured that the National Automobile Chamber of Commerce would approve it and it was therefore printed in the December issue of THE JOURNAL for presentation at this meeting.

Since it was printed, however, some matters bearing upon it have come up within the Rubber Association, and we were waited upon by a committee this morning, composed of Messrs. Allen, Hale and Thacher, who told us that it was their opinion that it would be a mistake for us to pass upon this report for a standard today because they felt that, while it was substantially correct, they would be able within the next few weeks to give us some definite recommendations in line with this report, but with a few modifications that they think should be made. They also said that these recommendations will embody a standard that can be maintained without further changes for some time to come.

Mr. Clarkson, Mr. Crane and I considered the matter but were unable to confer with Mr. Rice. We understand that Mr. Viles concurs in the recommendation of this committee that waited upon us and we have decided that it would be wise to withdraw this report at this time, with the distinct understanding that we will get co-operation from the tire and rim interests, and that we will have something definite to report at the Summer meeting of the Society.

ATTENDANCE AT MEETING

The members of the Standards Committee and the Society and the guests in attendance were

Standards Committee Members

F. W. Andrew
B. B. Bachman
F. C. Barton
W. J. Belcher
R. M. Bird
A. K. Brumbaugh
Earle Buckingham
T. V. Buckwalter
E. G. Budd
R. S. Burnett
A. G. Carman
E. R. Carter, Jr.
D. F. Chambers
F. C. Chapman
W. A. Chryst
E. L. Clark
O. H. Clark
C. F. Clarkson
J. Coapman
J. R. Coleman
H. M. Crane
L. A. Cummings
C. S. Dahlquist
P. J. Dasey
C. N. Dawe
B. H. DeLong
J. B. Fisher
C. B. Franklin
E. S. Fretz
C. F. Gilchrist
F. P. Gilligan
G. E. Goddard
L. M. Griffith
C. O. Guernsey
F. W. Gurney
W. S. Haggott
O. B. Harman
E. W. Hart
C. G. Heilman
S. P. Hess
C. E. Heywood
M. C. Horine
E. A. Johnston
L. S. Keilholtz
G. W. Kerr
W. C. Keys
C. T. Klug
F. C. Langenberg
G. L. Lavery
G. C. Loening
H. R. McMahon
Charles Marcus
G. J. Mercer
C. A. Michel
M. B. Morgan
H. C. Mougey
C. T. Myers
A. J. Neerken
W. M. Newkirk
G. L. Norris
W. C. Peterson
H. S. Pierce
W. B. Price
C. B. Rose
C. F. W. Rys
A. J. Scaife
C. H. Sharp
L. D. Simpkins
C. W. Spicer
H. J. Stagg
W. R. Strickland
J. G. Swain
R. G. Thompson
Sam Tour
J. G. Vincent
K. F. Walker
J. M. Watson
F. G. Whittington
Ernest Wooler
G. A. Young

S. A. E. Members and Guests

W. H. Allen
V. G. Apple
C. R. Armbrust
E. L. Aurand
F. C. Bahr
W. C. Baker
G. A. Barnard
G. C. Brown
N. B. Burkness
J. T. Caldwell
K. H. Condit
J. M. Cranz
R. H. Cunningham
B. Darrow
W. L. Demsey
N. S. Diamant
W. A. Dick
E. Dickey
F. J. Druar
W. H. Eisenman
L. M. Ellis
H. S. Firestone
F. H. Ford
D. E. Gamble
G. W. Gilmer
J. E. Hale
W. J. Hart
P. M. Heldt
L. C. Hill
L. S. Horner
R. K. Jack
E. J. Janitzky
G. L. Kelly.
T. S. Kemble
A. R. Kepler
Stephen Jencick
W. P. Kennedy
R. P. Lansing
J. Ledwinke
J. Linek, Jr.
M. T. Lothrop
W. T. Lutey
H. O. K. Meister
E. W. Miller
W. J. P. Moore
G. B. Muldaur
L. Ochtman, Jr.
L. Ottinger
W. J. Outcalt
J. F. Palmer
C. E. Phillips
S. P. Rockwell
R. F. Russel
E. F. Russell
G. A. Schanze
M. H. Schmid
W. G. Schneider
J. M. Schoonmaker, Jr.
J. R. Searles
R. H. Sherry
H. W. Slauson
F. G. Smith
H. H. Smith
R. O. Sperry
J. W. Stack
A. L. Swank
A. Taub
W. J. Taub
S. P. Thacher
F. L. Titchener
D. H. Tuck
G. A. Ungar
W. G. Wall
G. L. Wanamaker
J. F. Weller
J. J. Willard
W. E. Williams
A. D. Wilt, Jr.
O. W. Young

Harmony in Car Upholstery

By R. S. Quaintance[1]

Annual Meeting Paper

Taking the artist's viewpoint, the author discourses on the subjects of color, color harmony and the psychological effects of color, as a prelude to a discussion of how the decoration of car interiors can be made most effective, this being necessary because of the elusive quality of good taste, a quality of appraisal rather than one of creation, and because esthetic taste depends upon the degree of mental development of the individual, although possessed in some degree by all.

The primary, secondary and complementary colors are defined and their mode of selection is described preliminarily to a consideration of color values and the selection of the most effective color-schemes, application of these principles being made thereafter to the decoration of car interiors, inclusive of comments on the most suitable fabrics and patterns. The author believes that color will be considered eventually in the automotive industry as being on an equal plane with lines and form.

Harmony in car upholstery is a subject closely allied to color harmony in general; however, the decoration of car interiors is a new art in the sense that it is an old art newly applied. A car interior requires different treatment from that accorded a house interior; in fact, we must approach the subject from an entirely different angle because of its more or less public nature. Furthermore, owing to quantity-production methods that have made possible the extensive use of the closed car, it was essential in the past to exert extreme caution in designing fabrics for car builders that would prove acceptable to the greatest number of different personalities. The result caused restraint in conception to be the guiding rule. Unfortunately, this principle was not always recognized. The interior of a car has been treated at times as a piece of furniture to be upholstered as a boudoir with satins and hand-made lace, and all too often as a signboard whereon to write in blazing colors and patterns someone's ostentatious bad taste. It is time for a return to first principles. Good taste is an elusive quality, one of appraisal rather than of creation. The color scheme is the prime consideration in the correct decoration of motor-car interiors. The fabrics to be used are of importance also, but I will discuss the subject of color first.

In a broad sense color includes light and shade, and it is synonymous with light. It is safe to say that no subject has been more abused than color and I shall endeavor to clarify the entire subject of color harmony, or at least to convey a rudimentary knowledge of the subject so that the underlying principles, as applied to car interiors, can be understood.

The chief use of color is to beautify and, by its harmony, to appeal to the esthetic instinct. I believe that all persons possess esthetic taste, at least to a slight degree. We all know that taste is a matter of mental development. For instance, the child and the savage naturally prefer gaudy brilliant colors, but more mature and refined persons prefer somewhat subdued shades and tints. Many persons possess a natural color-sense. However, color knowledge is attained easily in sufficient measure to enable one to determine readily which colors are harmonious and which are not.

[1] Manager of sales promotion, Bridgeport Coach Lace Co., Bridgeport, Conn.

Color Harmony

Science maintains and proves every day that the orderly separation and coordination of simple facts will reduce the mysteries of yesterday to commonplace simplicities. Let us see what can be done toward simplifying the language of color and to define, in a measure, color harmony and its psychology.

We have the three pure colors of red, yellow and blue, as the basis of all other colors; they are elements in themselves, and cannot be produced by mixture. Accordingly, they are called primary colors; each of them in its full intensity differs widely from the others in tone and quality. A number of other colors are in the spectrum and are termed binary or secondary colors. They are formed by mixing equal parts of two primary colors. For instance, when we mix equal parts of red and yellow, we produce a binary color, orange; yellow and blue mix to form the binary color, green; and blue and red mingle into the binary color, violet, thus completing the circle. We now have six colors and have widened the field considerably.

In the application of colors to decorative design, the binary or secondary colors are vastly more interesting than the primary colors. Any color with two component parts is more interesting than a purely elemental color. For instance, orange has greater decorative value than either yellow or red, green has more "quality" than either blue or yellow and violet is decidedly more interesting than either red or blue. Like the primary, the secondary colors can be combined effectively with any or all of the neutral tones, white, black or gray. It is possible also at this stage to harmonize colors by using complementary or opposite colors.

Complementary colors are those which, if all colors were arranged around the circumference of a circle in proper order, would be exactly opposite the primary colors; in other words, by drawing a line from the red through the center of the circle, we would find that green is the complementary color. A primary and a complementary color form the strongest possible contrast to each other. It is not possible to find a color more different from red than green; they have nothing in common. However, these same colors have the peculiar power to enhance each other when placed side by side. Each seems to gain strength. A red apple looks redder when it nestles among the green leaves and the leaves look greener near the red apple. Another peculiar thing about the complementary colors orange and blue, yellow and violet and red and green, is the fact that they destroy each other when mixed together as in paints. A mixture of equal parts of any two complementary colors produces a neutral gray.

Color Psychology

To appreciate color harmony, it is necessary to know something of the psychology of color and the influence it exerts upon the emotions. It is a well-established fact that the entire personality is stimulated or depressed by

colors, and very many data are available on the effects of visual color-stimulus upon the blood pressure, upon muscular, mental and nervous activity and upon the mood, and these effects are evident in many ways.

The esthetic significance of color was recognized many centuries ago; in fact, much of the psychology of color appears in mythology. Xenophon reports a conversation between Socrates and Parrhasius in which the esthetic value of color is shown to have been appreciated by the early Greeks. Plato also discusses the beauty and symbolism of color and reveals his acquaintance with its ability to excite emotional response. The influence of color is positive, and so is the difficulty to analyze it. Has not everyone felt the influence, the purity of freshly fallen snow and experienced a feeling of resentment or guilt when this beautiful white cloak is wantonly soiled or disturbed?

The meaning of colors, their language, already is established by common consent throughout the ages. We cannot ignore it. Not all can understand the causes of some of their sensations of happiness or comfort, but many of them are definitely traceable to the proper use of color. The recognition of beauty of color and the finer feeling toward colors are dependent in large measure upon the taste of the beholder. To repeat, taste is largely a matter of mental development. The eye loves color. Whether conscious of it or not, all people react or respond to the influence of color. Color has power to attract attention, to stimulate emotion, to animate and cheer or to quiet and depress.

Color is not as well understood as it should be for the reason that artists have maintained it as their own private preserve. They built a barbed-wire fence about it and put up a sign reading, "Thou shalt not trespass." They contend that, aside from a few general principles of color harmony, the realization of satisfactory color arrangements depends on esthetic instinct.

The phase of color study which the charts cannot touch is a kind of inner shrine that we may term its psychology. Wholly apart from color sources, dimensions or harmonies, what are the effects different colors exert on personal feelings and emotions? Why do we feel cheered and enlivened by light tones of color and depressed by the darker tones? Why, for instance, is red a more exciting color than blue? Why do we speak of colors as warm or cold when there is no physical sensation of heat or cold? Why are orange, yellow and red called advancing colors and blue and violet termed retreating colors? All these and many other questions are answered in the study of color psychology.

It has been known for centuries that colors are either warm or cold, and scientists have established definitely that some colors are retiring an others are advancing. Colors are either stimulating or depressing, as well as either warm or cold. It is seen readily, when looking at the spectral band, that colors on the red side are warm and the colors on the blue side cold. We think of sunshine as being warm. Yellow is the color of the sun; hence, a tint or shade containing yellow is called a warm tint or shade. It gives us the feeling of vitality and warmth. It is the symbol of action, of courage. Red stimulates and excites. When we are stirred with strong emotion, such as anger, bashfulness or hatred, the red blood leaps from our hearts and flames in our cheeks. Red is far more attractive than yellow and is conducive to the thought of heat, an element that is lacking in yellow. Who has not felt the cockles of his heart warm and expand before an open fire? In a room otherwise dark and gloomy, it seems a living thing. Gilbert K. Chesterton expresses our attitude toward an open fire in these characteristic words:

> A queer fancy seems to be current that an open fire exists to warm people! It exists to warm their hearts, to light their darkness, to raise their spirits, to cook their chestnuts, to tell stories to their children, to make checkered shadows on their walls and to be the red heart of a man's house and hearth, for which, as the great heathen said, "a man should die."

Color Values

Red is a warm color of great power. Yellow, orange, the browns and their neighboring hues and tints are warm colors. All of the brighter colors are symbols of light and warmth and in this sense yellow is gaudy, gay and enlivening, and naturally emblematical of the sun.

Blue logically is associated with serenity, sedateness and cold calmness, and probably has been so associated through centuries of contemplation of the sky or heavens. Due to its being the color of the sky, it is characterized as dignified and soothing. It signifies melancholy as well as sedateness. Blue is everything that yellow and red are not. It is quiet, reserved and cold. We speak of the icy-blue stillness of the Far North, of cold steely blue eyes and of having the "blues" when we are conscious of a lack of enthusiasm over life's affairs. In fact, coldness is the outstanding feature of blue and is communicated in varying degrees by all colors that contain blue components.

The cold colors are predominantly restful. However, they may be either agreeable or disagreeable. Their associations determine their agreeableness and these generally operate through sub-conscious channels. The war colors generally are stimulating. But, as there are various degrees of stimulus, the warmer color also may be either agreeable or disagreeable.

Just why certain combinations of color are pleasing and others disagreeable, or even shocking, it is difficult to say. The question can be answered by stating that the combination is either harmonious or discordant. Harmony is merely a pleasing arrangement of colors; this is analogous to harmony in music, which is produced by pleasing arrangement of musical notes. In music, we know that rythmic experiences or sounds are much more agreeable than those which are non-rythmic. We must apply the same sort of rule to color. As an art, coloring is on an equal plane with music. However, as an exact science, music is far in advance.

Color Schemes

It is a well-established fact that the eye is pleased with a group of colors that show all of the primary colors in at least some degree. In color sensations the presence of all three colors appears to complete the color circuit. It is very difficult to explain this, and it must be accepted as a fact. As an instance, doubtless everyone has, at some time or other, tried the experiment of gazing intently at a round disc of strong red on a white background. If the red disc is suddenly removed and one continues to gaze at the white background, a green disc will appear. Green is a combination of yellow and blue. The eye has supplied the complement to the color that so filled it a moment before, proving that certain colors seem to call for or demand certain other colors.

Color harmony cannot be achieved by selecting any two or more colors from the spectrum at random. It is essential that the colors chosen be at equal intervals from each other. We find, here, an analogy in music.

Two harmonious colors can be chosen from a color cir-

cle by selecting two complementary colors as has been described; that is, two colors exactly opposite to each other on the color circle are harmonious. I will now describe how to locate three-color harmonies by using an equilateral triangle to insure an equal interval between the color steps. If we place the triangle with the apex at yellow, the other two angles will locate the other colors in the color scheme, red and blue; and in traveling around the color circle, we locate the secondary and the neighboring colors. Having a proper regard for area, the three colors in each group can be used together in respect to the hue and luminosity of each color, in any value or intensity, and with gray, white or black, and can be depended upon to produce harmony. However, do not misunderstand me; the primary and secondary colors located by this simple method would not be suitable for use in closed-car interiors.

Another method of arriving at a color scheme that combines all the primary colors but in far more subtle proportions is by varying the interval. Just as there are different intervals in musical harmony, the majors and the minors, there are different intervals in color harmony. This gives us what is termed a split complement. The three points of this triangle can be made to travel around the color circle and locate the different split complements. These combinations contain also all of the elements of the straight complement or all of the primary colors; but they are present in different proportions.

Decoration of Car Interiors

It cannot be emphasized too strongly that, in the natural expression of refined taste, the purer color must be used sparingly and with great care. The tints and shades or tones are to be favored. The chief function of the purer colors is emphasis only or, if one can so refer to it, the purer colors are for punctuation only. While it is agreed by most students that complementary colors are harmonious, there are certain conditions that must be considered, chief among which is area. For instance, green is the complementary of red. For certain purposes this combination is an excellent one. When applying it to a closed-car interior, we must neutralize the dominant hue. Professor Munsell has compiled a color chart which shows that red is twice as strong as green in what he terms "chroma." In this instance, we will regulate the area; so that our dominant color is green and considerably lowers the value of the red by darkening it. The green itself might well be grayed, preferably to an olive, and we then find, in applying the two complementary colors to a closed-car interior, that the color scheme has worked out to an olive-green cloth with a maroon stripe. It is a combination that is suggestive of spring and of the garb of nature and is representative of life, youth and freshness; a combination of warm and cold colors that is agreeable and restful, since the maroon stripe supplies sufficient life to tone-up the combination.

In passing it may be well to remark that nature supplies a wealth of harmony which must be studied to be appreciated. The student will observe quickly that nature employs a relatively small amount of pure colors. Even the beautiful sunsets are devoid of pure colors; all of the beautiful effects arise from ever-changing combinations of tints and shades.

A point to be borne in mind in regard to harmony in car upholstering is the fact that the less obvious the color element is, the more quality the different tones possess. This is applicable equally to color harmony in other fields.

The warmer tones are to be preferred for use in a closed car as against the colder tones. By those who have understood the subject, the warmer tints have been selected with a view to making the interior cheerful and inviting in its appeal, and to make it as pleasant as a well-appointed drawing-room in its season of greatest usefulness, winter. The same interior can be made cool, quiet and restful during summer, by the use of slip-covers having a color scheme based upon the cold side of the color circle. Slip-covers serve other purposes, chief among which is the protection of the upholstery from dust and dirt during periods in which the windows frequently are lowered when driving.

A still different kind of color harmony that, I am sorry to say, is extremely popular with many car-builders, is what is termed a mono-chromatic group. This is made up of two or more tones of the same color. It is the most unobtrusive and conservative harmony scheme possible. It is always safe, but seldom interesting. There is, however, an even more severe treatment, that of employing a single solid tone. This practice requires painstaking care in the selection of laces, curtains, curtain cords and other trimming accessories to insure perfect matching. I have seen some excellent examples of this type in the products of custom body-builders, but I do not commend its use to large manufacturers. This treatment would not wear well with some personalities; it would become extremely monotonous and probably tiresome.

In the mono-chromatic harmonies, those employing two or more tones of the same color and any other schemes except the solid tone, it is possible to give the interior that natural balance of light over darkness that is considered of prime importance in all decorative fields. In this case the floor covering would be of the darkest shade, the body cloth a trifle lighter, and the trimmings and head lining, if one is used, of a still lighter shade. In interiors of this nature it is possible to make the color scheme interesting by the use of one or more bright spots such as an enameled handle or vanity case, or by using other interior fixtures. This should be of a color complementary to the dominant color. If we must have mono-chromatic car-interiors, let us at least liven them up. If we insist that the cloth manufacturer supply us with fabrics containing two or more neutral shades, then let us *save* the interior; let us liven it up by the intelligent use of spots of color in the other interior fittings.

I wish to urge, however, that we be reasonable. Judging from the descriptions I have read of the cars shown at the recent Paris Salon, our European friends have achieved some remarkably grotesque discords in this line; apparently, this is a reaction from the recent war. Some of the cars shown must have been extremely ludicrous; nevertheless, we can learn much from the Europeans. Not all of their creations are to be classed as freakish; in fact, all Latins are more artistic than Saxons, as a rule and, generally, they are much more fond of color.

Fabrics

There are three general types of fabric, cotton, wool and mohair. Of the first, cotton, little need be said. Cottons are used generally in the cheaper cars only, although the cotton velours had an extensive run in the medium-grade cars during the war period, as did the cheaper cottons also. These velours, while giving a rich luxurious effect, are not as serviceable as mohairs or woolens. The mohairs woven from the hair of the angora goat are extremely serviceable and have enjoyed several years of popularity. But the fabric that seems to be the most desirable from all angles of style, wearing quality

and appropriateness is the various kinds of woolen cloths. They vary in weaves and weights and a particular type can be found for any upholstery purpose.

A point to be borne in mind when selecting fabrics is that any pronounced figure will soon grow extremely tiresome. The eye requires complete rest in a closed car, rest from the continuous motion outside. The influence of the interior should be one that is felt rather than seen; for this reason the brocades, tapestries and chintzes, or other furniture upholsteries, have no place in the correctly appointed motor-car. The pattern should be small and unobtrusive and appear in the body lining only.

Some manufacturers have experimented extensively with woolen cloths and today are weaving a cloth on looms especially designed for automobile fabrics. Special finishing machinery has been built to impart a broadcloth finish to all woolen cloths. A fabric that promises to become extremely popular is the new worsted cloth. Some of this is all worsted, and some grades are only worsted-faced. These cloths trim well and have unusual wearing qualities. Another new fabric that has great promise is the mohair sateen, a flat woven mohair. This can be made in a wide variety of shades and various patterns and, strange as it may sound, it is guaranteed by the manufacturer to outwear the car.

In conclusion, I want to enter a plea for more color; more color in the interior and more color in the exterior. We literally have worked the funereal color, black, to death. For years we have painted the majority of our cars black. We have had too much of it. We should brighten the cars with color. As a result of the continued practice of using black, we have killed many an owner's pride in his car. When one drives home in a new car in these days, it is impossible to feel that one is creating any stir in the neighborhood. In fact, one's neighbor is very apt to remark over the back fence, "I see you got the old bus washed up."

Recently, while in Havana, I was very agreeably surprised to note the difference in the appearance of a long line of automobiles from that noticeable here. Every car in the line was clean and shiny and fully half of the cars were painted in colors other than black. They are very fond of color in Cuba but, to be frank, they know how to use it. A parade of automobiles in Havana is an interesting thing to watch.

Much attention has been devoted in the automotive industry to the subjects of line and form. Color has not yet played a leading part but, sooner or later, color will come into its own and be on an equal plane with line and form. When this occurs and the automotive industry comes to an appreciation of the commercial value of beauty in color, we will find that color will not only supply the atmosphere and the drapery, but play a dominant rôle.

THE THOMPSON AUTORIFLE

THE development of a semi-automatic self-loading military rifle, weighing less than 10 lb. capable of firing high-powered cartridges, has been a perplexing problem of gun designers throughout the world. Self-functioning and automatic arms have been operated by (*a*) the blow-back of the gas against the head of the bolt; (*b*) a gas-operated piston that in turn operates the bolt; and (*c*) the force of recoil. With the advent of the Thompson autorifle and the Thompson submachine-gun, another system of automatic breech-closure is added, namely, the self-acting lock in which the bolt is in the form of a wedge or a screw and which in itself without other accessories constitutes at once an automatic lock and release. This is accomplished by the principle of adhesion, about which, outside of the experiments of Gen. John T. Thompson and his associates during the last few years, little is known. A study of this new principle shows the advantages of the self-acting lock by reason of its extreme simplicity and consequent saving of weight, overcoming at the same time many of the basic engineering problems involved, as the weight thus saved can be placed where most needed. This principle was observed and patented by Com. John Blish of the United States Navy, and presented to a special Board of Naval Ordnance before the world war.

The first piece of mechanism that successfully demonstrated the Blish principle was the Thompson submachine-gun, now generally known and on the market. In this form the simple wedge was successfully used as a self-acting lock. The next development of the principle has been the Thompson 0.30-caliber autorifle, in which the screw form of bolt was utilized as the self-acting lock. The autorifle has been basically considered as an engine; in fact as a double-acting gas engine in which the bullet and the bolt have motions of translation in opposite directions and are moving pistons.

Those experienced in the actual use of automatic guns are almost unanimously agreed that the oiling of cartridge cases insures more certainty of action. In fact, cartridge-case oiling was prevalent in the field during the world war. This practice was accomplished crudely with an oil-can before loading. The reason for this is obvious when it is realized that extraction, which is the heart of the automatic problem, requires varying forces. The extraction pull necessary for cartridges has a wide variance due to the adhesion of the case to the chamber and also because in some gas and recoil automatic guns the instant of applying or timing the pull is not always the same for each shot, especially where the rate of fire can be regulated in such guns. The autorifle is loaded in exactly the same manner as the service rifle. In doing so, however, the cartridge cases are automatically oiled. This changes the back-pressure on the bolt from that known to be exerted by dry cartridges. Hence, after exhaustive tests, its use in the service rifle has been discouraged by certain experts. However, in guns specially designed and with mechanisms timed particularly for such pressures as in the Thompson mechanisms, this point is safely taken care of and large factors of safety are secured. As the bullet is neither oiled nor greased, the ballistic qualities of the bullet remain unaltered. The mechanism, however, gives a considerable reduction in recoil with corresponding advantages in the accuracy of firing.

In appearance and general form, the Thompson autorifle is a replica as far as possible of the present United States service rifle. In fact, out of a total of 95 component parts for the United States Model 1903, 30 of the total 86 parts of the autorifle are the same as in the service piece. The design allows the autorifle to be dismantled completely and assembled rapidly. Dismantling for replacement of moving parts is accomplished without the use of tools and is simple. Comparing the gun mechanism proper consisting of all parts necessary for free functioning the autorifle has 44 parts contrasted with 42 for the United States Model 1903. The total weight of the autorifle is 9 lb. 10 oz.

Magazines are either detachable holding 10 or 20 shots or fixed as desired, the latter holding the regulation five cartridges. The autorifle can be used conveniently as a hand-loaded weapon when desired, reserving the semi-automatic feature for emergencies. The mechanism functions equally well with powder charges 40 per cent below or above normal pressures of 50,000 lb., without adjustment of any kind.

American Marksmanship

Turning from the mechanical aspects of the military semi-automatic problem to the tactical considerations of the case,

(*Concluded on page* 144)

Air-Cooled Engine Development

By Charles L. Lawrance[1]

Annual Meeting Paper *Illustrated with* Drawings

THE development of air-cooled engines for aircraft never made much progress until the war, when the British attempted to improve the performance of existing engines by a series of experiments leading eventually to the development of aluminum cylinders with steel liners and aluminum cylinder-heads with a steel cylinder screwed into the head. The advantages of these constructions and the disadvantages of other types are discussed. Results are reported of tests at McCook Field on a modern cylinder-design of this type showing good results, that lead to the belief that large air-cooled engines will be produced in the near future, equal in performance to water-cooled engines of the same power. It is claimed that, at present, there is nothing to choose in performance between water-cooled and air-cooled engines of about 25 hp. per cylinder, and that air-cooled engines of this size can be built successfully of the same compression-ratio and having the same fuel-consumption as high-compression water-cooled types.

An explanation is given of the reason for the advantages of aluminum cylinders and head constructions, and a chart is presented showing the temperature on the front and the rear of a large air-cooled cylinder of high output. The question of the cylinder-wall temperature of air-cooled and of water-cooled engines is discussed, and it is indicated that there is not much difference in temperature between the two types. The water-cooled engine is at a disadvantage on account of the number of heat transfers from one medium to another before the heat reaches the air. A statement is given of the reason air-cooled engines can perform satisfactorily with less cooling area than is required for water-cooled engines.

The subject of the resistance of airplanes having air-cooled and of those having water-cooled engines is discussed, attention being drawn to the fact that little is know of the best methods of installing and cowling these engines. Various suggestions are made for possible future development of cowling, to permit airplanes equipped with air-cooled engines to offer as little resistance as those equipped with water-cooled engines.

THE use of air-cooled engines in aircraft is not of recent origin; but, except in the field of rotary air-cooled engines, it is only within the last few years that it has attained any importance or been regarded seriously by most aircraft and powerplant engineers. From the time that Bleriot crossed the English Channel in an airplane equipped with a 25-hp. air-cooled Anzani engine, such as is shown in Fig. 1, there has been some steady development of air-cooled engines, limited, however, to very few companies. For a long time the Anzani, Nieuport, R.E.P. and Gnome engines were about the only well-known air-cooled powerplants built, of the type shown in Fig. 2. I believe it is of interest to compare the design of several of these early engines with that of some of the later types. It is not my intention to take up the subject of rotary air-cooled engines, as the production of this type has been practically abandoned.

The Nieuport engine was a great step in advance. It had mechanically operated valves, cylinders having good fin-area and would be considered more or less uptodate

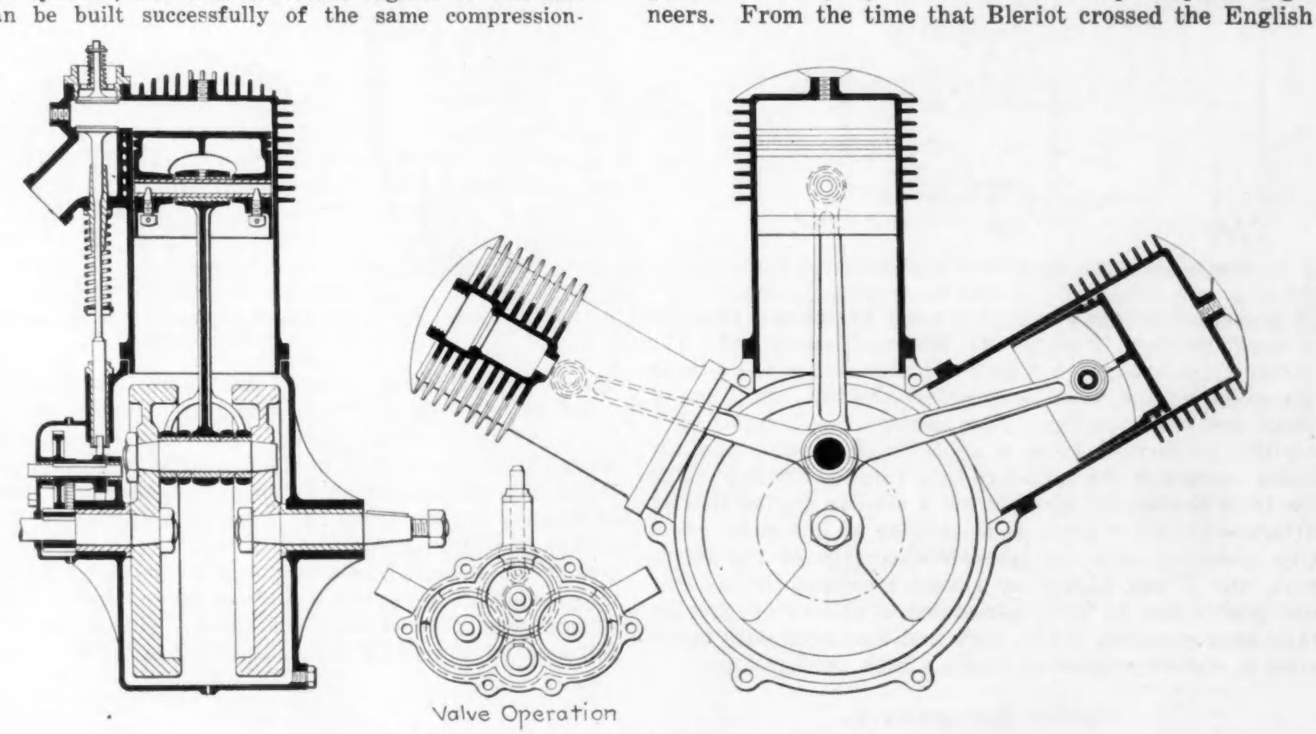


Fig. 1—A 25-Hp. Air-Cooled Anzani Engine

[1] M.S.A.E.—President and chief engineer, Lawrance Aero-Engine Corporation, New York City.

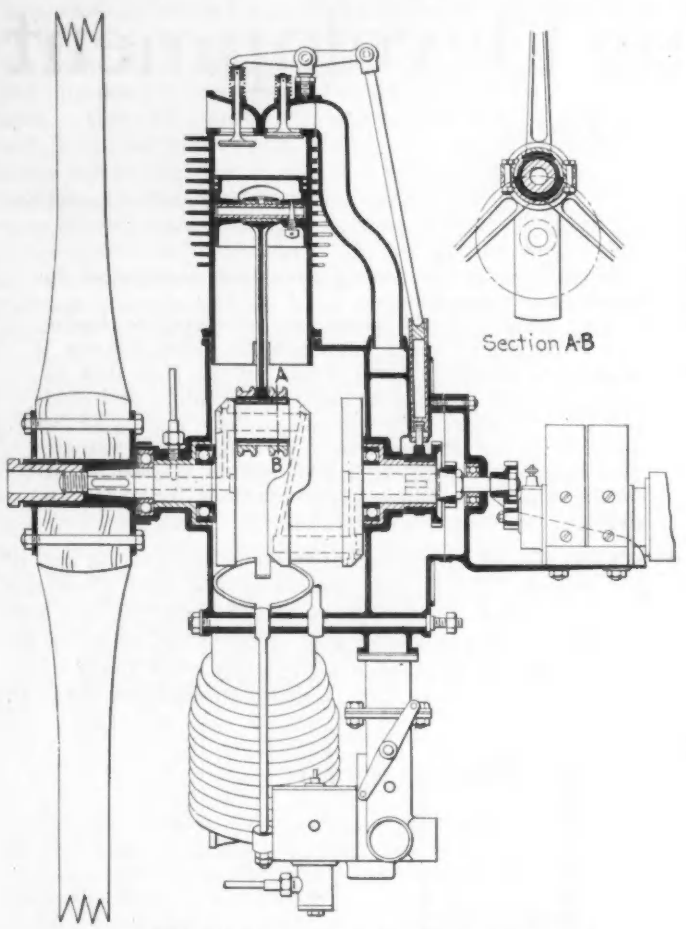


FIG. 2—SECTIONAL ELEVATION OF THE ANZANI ENGINE

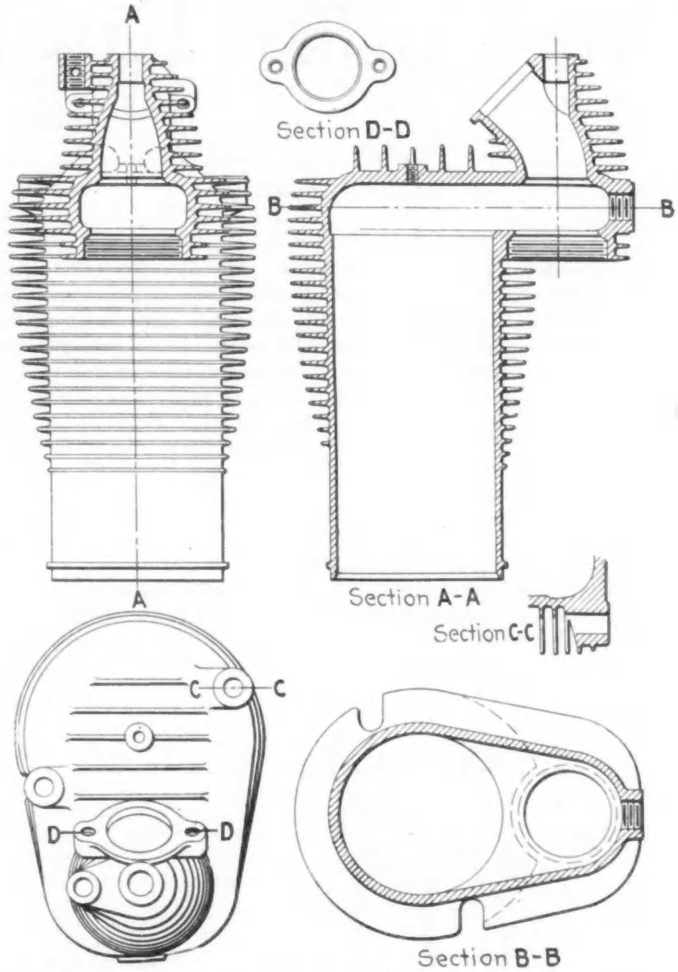


FIG. 3—THE ORIGINAL AIR-COOLED CAST-IRON CYLINDER DEVELOPED BY THE ROYAL AIRCRAFT FACTORY

at present, but this development was abandoned after an aircraft accident in which Mr. Nieuport was killed. The Renault Co. brought out an 8-cylinder and a 12-cylinder air-cooled engine some years before the war, and some of them are still running. They are of the V-type. The cooling is derived from a centrifugal blower, the air being carried to the cylinders by a form of cowling. The De Dion Bouton Co. brought out a similar engine shortly afterward. All of these engines were of low mean effective pressure, with the possible exception of the Nieuport, and it was agreed by almost everyone that it was not practicable to build air-cooled cylinders of greater than approximately 4.5-in. bore and that even with these sizes it was impossible to obtain a high performance.

BRITISH EXPERIMENTS

The British, with a view to improving the performance of existing Renault engines and the Royal Aircraft Factory engines, which were more or less similar, started a series of experiments about 1916 which carried them very far. The original Royal Aircraft Factory cylinder shown in Fig. 3 developed only a mean effective pressure of 85 lb. per sq. in. and had a fuel consumption of 0.67 lb. per b.hp-hr. It is easy to see that this cylinder had entirely inadequate exhaust-valve and head cooling. An attempt was made first to improve this cylinder by casting it in aluminum with slight modifications of design and with a shrunk-in steel liner. This is, so far as I know, the first instance in which the construction, shown in Fig. 4, was used. In this cylinder the mean effective pressure was no better than that of the cast-iron cylinder, but the fuel consumption was reduced to 0.57 lb. per b.hp-hr. These two cylinders were of 4-in. bore, and it was decided to build an improved design of cylinder of 4.5-in. bore having overhead valves. This also was an all-aluminum cylinder with a shrunk-in liner and steel valve-seats cast in the aluminum head, as shown in Fig. 5. It is easy to see from the location and cooling of the valves and the large fin-area that a great improvement was to be expected, and this engine actually showed a mean effective pressure of 108 lb. per sq. in. and a fuel consumption of 0.54 lb. per b.hp-hr. This cylinder was followed by a still larger cylinder of 4.75-in. bore, but

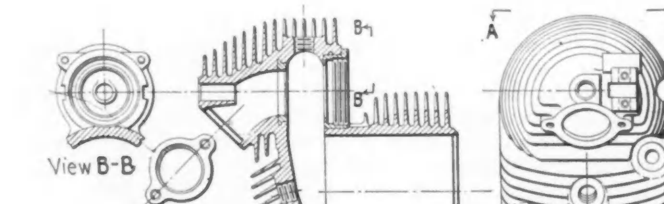


FIG. 4—THE ROYAL AIRCRAFT FACTORY AIR-COOLED ALUMINUM CYLINDER DESIGNED FOR A STEEL LINER

of the same general design as shown in Fig. 5. It is very much like the type used today in air-cooled engines. It showed a mean effective pressure of 118 lb. per sq. in., a fuel consumption of 0.505 lb. per b.-hp-hr. with a compression-ratio of only 4.6 to 1, which is almost as good as can be obtained today under the same conditions.

A number of improvements were then carried on with a view to finding the best material and construction for a cylinder liner. It was found that the shrunk-in construction, although satisfactory when the engine was new, permitted the oil to get between the cylinder wall and the liner, thus decreasing the cooling efficiency after the engine had been run for a time. Our experience, however, has shown that where the cylinder and liner were properly machined and shrunk together with the proper fit, the falling-off in power after a great many hours of running is negligible and the increase of fuel consumption very small.

The construction shown in Fig. 6 has great advantages over the method already mentioned as having been adopted by the British, where the liner was clamped in place against a shoulder at the top with a view to keeping out the oil. A clearance between the aluminum holding-down flange at the base of the cylinder and the crankcase is necessary in this construction. On account of unequal expansion of the liner and the cylinder, the tightness of the joint between the liner and the top of the cylinder is an unknown quantity, when the engine is hot, and the question arises regarding the proper tension of the holding-down bolts that leaves too much to the personal element. This construction is shown in Fig. 7. In addition to the trouble due to oil leakage, an examination of the cylinder and the liner after running showed a considerable lack of contact that did not, however, appreciably affect the performance for cylinders up to 4.75-in. bore, but for larger bores it was thought desirable to find another method of construction. Accordingly, experiments were made by casting an aluminum head on a steel cylinder, as shown in Fig. 8. This construction did not prove altogether satisfactory, according to a British report, as it was hard to get a bond between the two

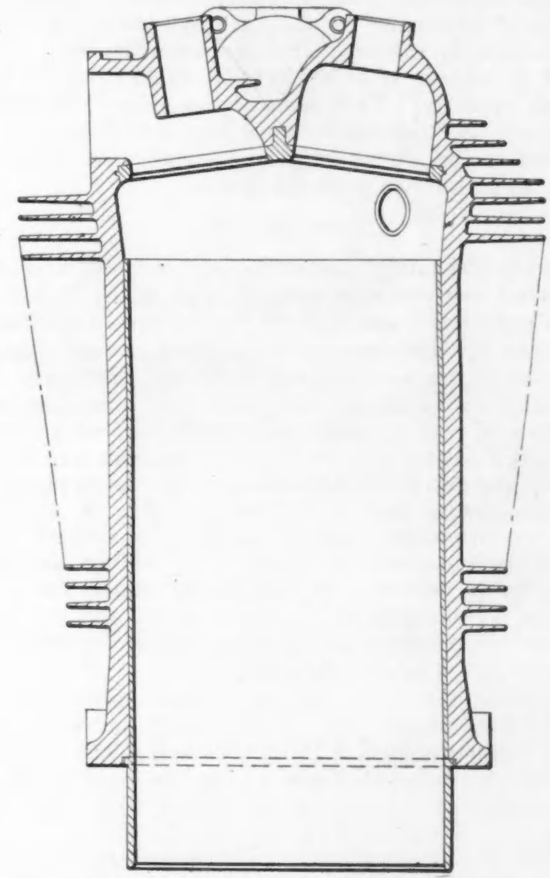


Fig. 6—The Lawrance Model L Cylinder

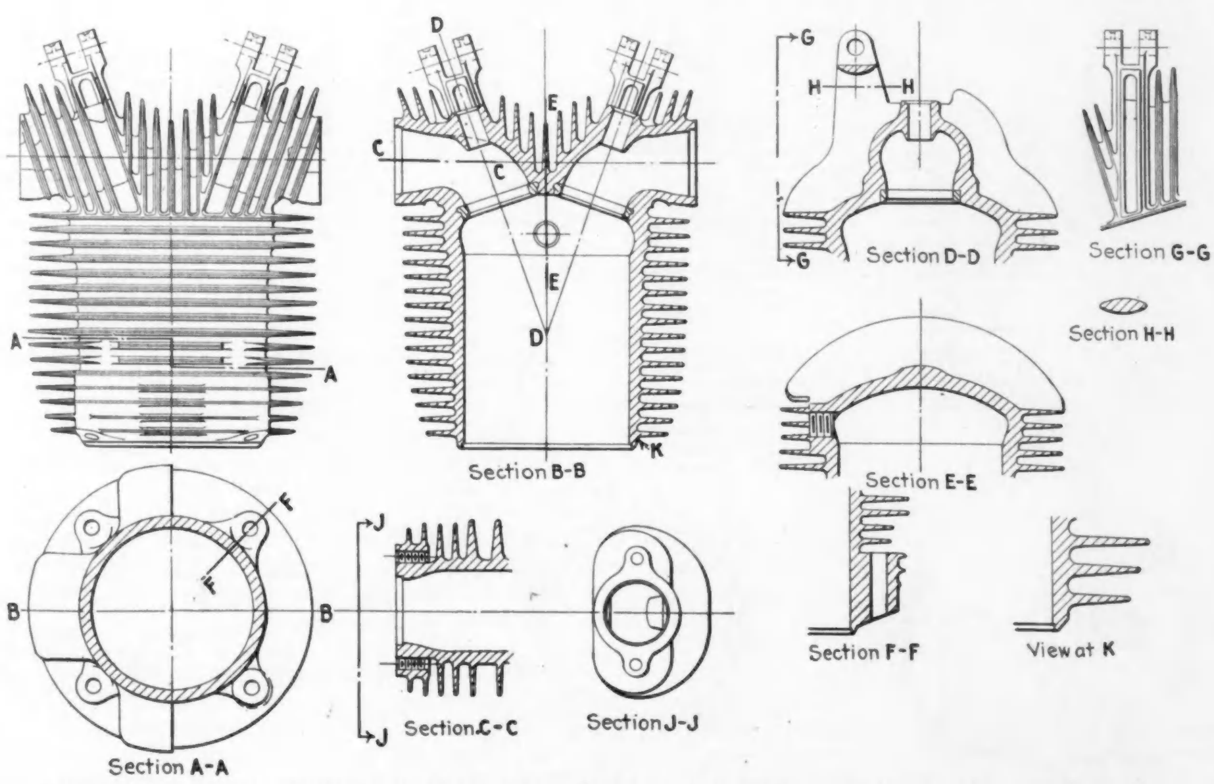


Fig. 5—A British Air-Cooled Aluminum Cylinder Having a Shrunk-In Steel Liner and Steel Valve-Seats Cast in the Cylinder-Head

metals, especially because the difference in their coefficients of expansion tended to break down any contact that originally existed. These experiments were corroborated by experiments at McCook Field on a Weinberg engine recently. They showed not only that this was true, but also that the stresses due to shrinkage in casting caused the aluminum head to crack, and this method of construction has been abandoned.

Types of Engine

During the latter part of the war several large radial air-cooled engines were brought out by the British. In these engines it was thought to be too much of an experiment, probably on account of the large cylinder sizes required, to use an aluminum head and they were therefore built with steel cylinders and heads more or less on the lines of rotary radial-engine practice. One of these, the A. B. C. Dragonfly, having a 5.5-in. bore and a 6.5-in. stroke, was designed, built and put into large production without having had much testing. Fig 9 shows the A. B. C. Dragonfly engine cylinder. This engine never proved satisfactory, on account of cooling and other troubles. It will be seen that the provision for cooling the head of the cylinder is practically nil and, in view of this, the low brake mean effective pressure of 100 lb. per sq. in. obtained is not surprising.

Somewhat later, the Jupiter-Cosmos engine shown in Fig. 10 was brought out. This engine had even larger cylinder dimensions, a 5.75-in. bore and a 7.50-in. stroke. An attempt was made here to cool the head by an aluminum cover containing the valve-ports, which was bolted to the top of the steel cylinder-head. This cover was supplied with cooling fins. This engine showed marked improvement over the A. B. C. Dragonfly engine in cooling and other details, but it was found that the contact between the aluminum cover and the steel cylinder-head was poor, due to warping of the two parts in question. A

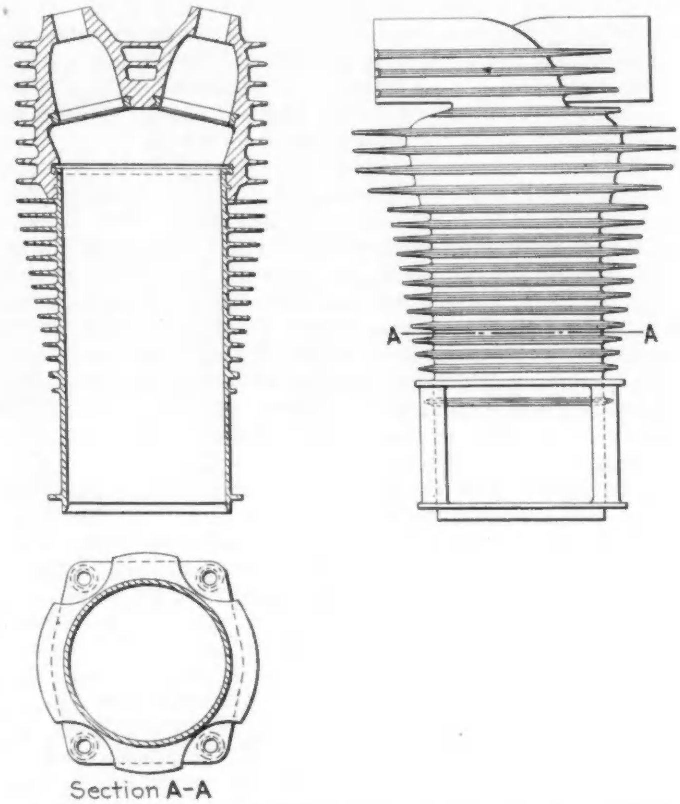


Fig. 8—A Type of Air-Cooled Cylinder Subsequently Developed by the Royal Aircraft Factory in Which the Aluminum Head Is Cast on the Steel Cylinder

radial engine having cylinders of this type was built in the United States by the Wright Aeronautical Corporation, having a $5\frac{5}{8}$-in. bore and a $6\frac{1}{2}$-in. stroke, which

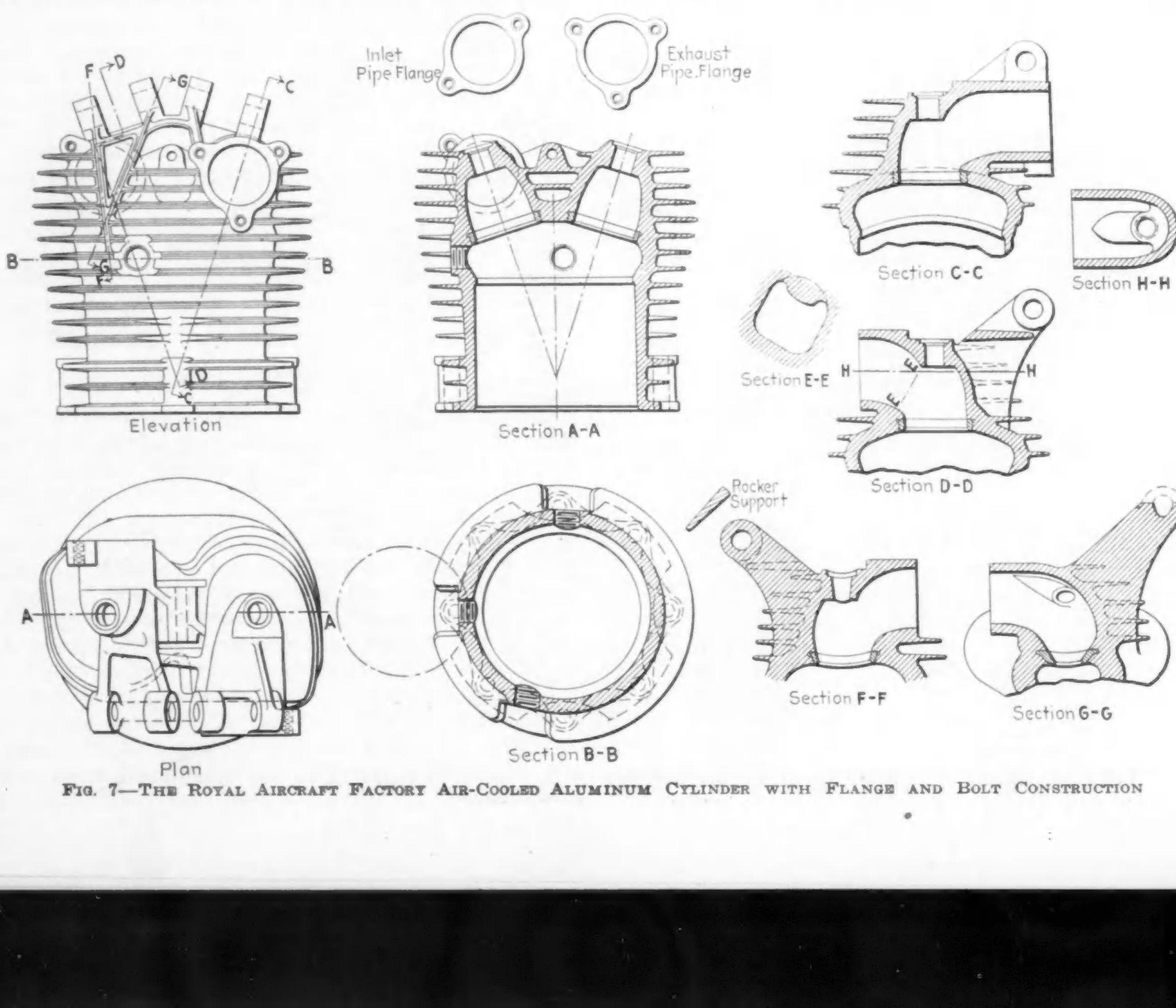


Fig. 7—The Royal Aircraft Factory Air-Cooled Aluminum Cylinder with Flange and Bolt Construction

showed a somewhat better performance; but this design of cylinder has been abandoned since in favor of a new type that has been developed for this engine. It is giving good results and will bring the performance to par with the best water-cooled engines.

Appreciating the difficulties encountered in these designs, the British carried on some experiments and produced a cylinder construction in which a steel cylinder is threaded into an aluminum head, that appears to be satisfactory. Experiments along these same lines have been made recently at McCook Field, in which the cylinder and head are assembled as already described after the head has been heated to about 700 deg. fahr., with a sufficient shrink-fit to make a very tight job, as indicated in Fig. 11. This construction appears to combine all of the advantages of the various systems already described. The steel cylinder has sufficient cooling-area on the barrel, and is of very light construction. The thick aluminum head of high conductivity and large fin-area is particularly suited for the dissipation of heat.

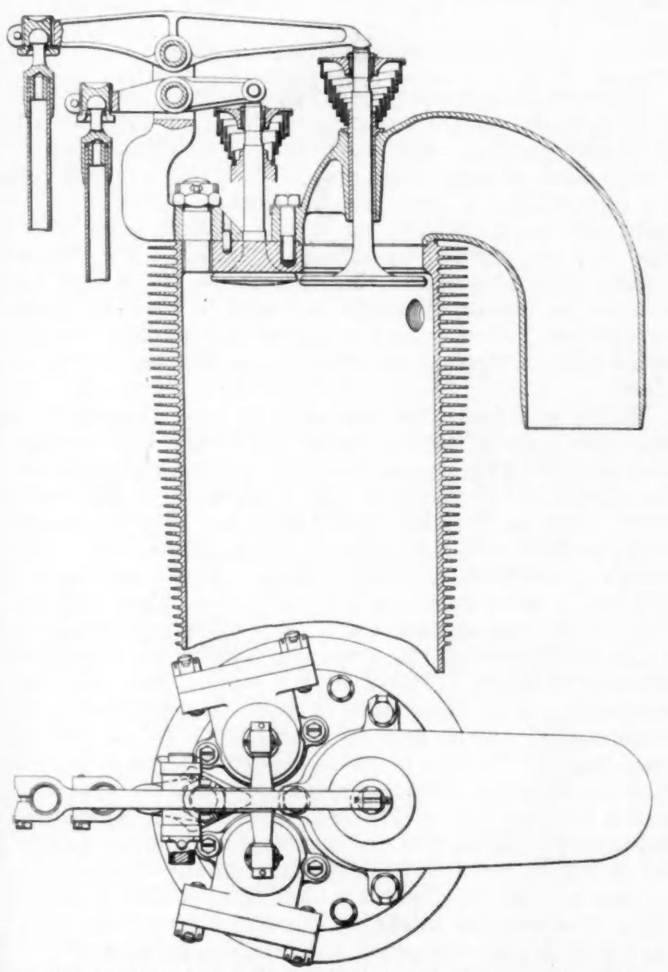


Fig. 9—The Cylinder of the A B C Dragonfly Engine

A cylinder of this type having a 5⅝-in. bore, a 6½-in. stroke, and a 5.3 to 1 compression-ratio has just been completed at McCook Field and been run in some preliminary tests. The fuel used was composed of 50 per cent of benzol and 50 per cent of average gasoline, and the results are shown in Table 1.

These tests were almost the first ones made with this cylinder, and were to test it for mechanical soundness rather than for performance. They were made with a casual carbureter-setting and are not by any means the best results obtainable. From this it might be inferred

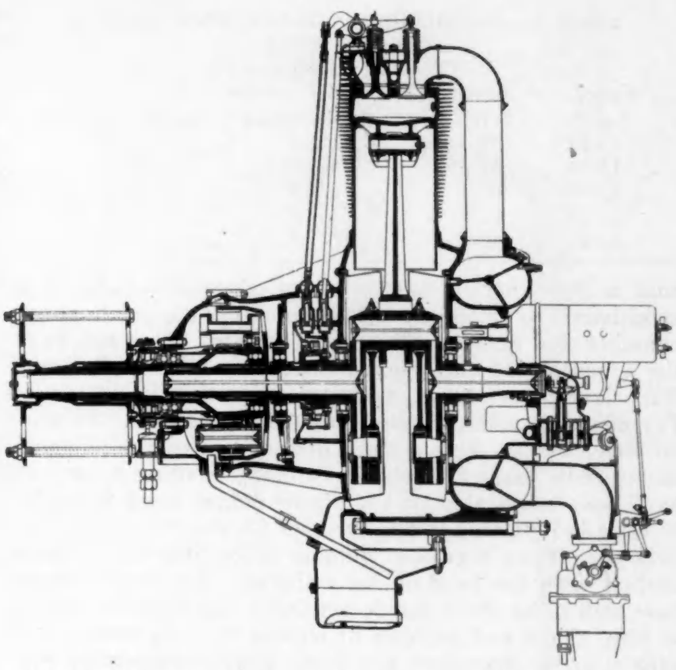


Fig. 10—Elevation Partly in Section of the Jupiter-Cosmos Engine

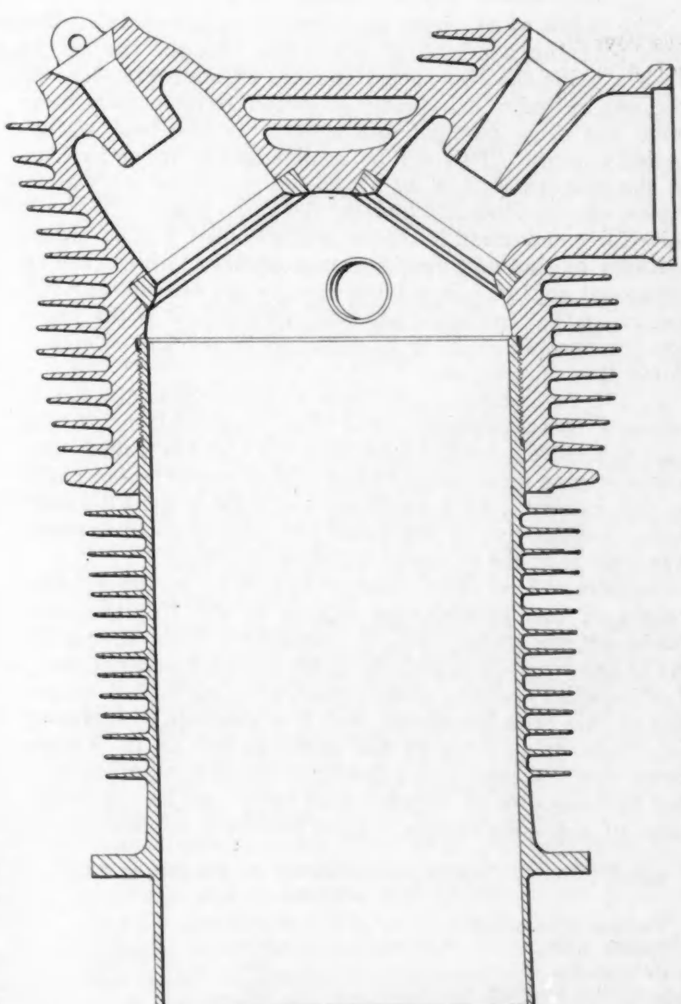


Fig. 11—An Experimental Steel Cylinder with a Screwed-On Aluminum Head That Was Developed by the Air Service at McCook Field

TABLE 1—PRELIMINARY ENGINE-CYLINDER TESTS AT MC COOK FIELD

Speed, r.p.m.	Power, b. hp.	Brake Mean Effective Pressure, lb. per sq. in.	Fuel Consumption, lb. per b. hp-hr.
1,430	37.4	128.2	0.56
1,590	42.3	130.2	0.56
1,670	44.6	130.8	0.56
1,770	47.3	130.8	0.56
1,900	49.5	127.6	0.56

that a construction having a cylinder consisting of a steel barrel to which are bolted an aluminum combustion-chamber and head, as illustrated in Fig. 12, would have the advantage of cheapness without any loss of efficiency. Experience has shown, however, that this is not true. For efficient cooling of the combustion-chamber, the aluminum must be carried some distance down the sides of the cylinder barrel to obtain sufficient cooling area. It has been shown also that a highly-domed head is desirable, as is indicated in the cylinder illustrated in Fig. 11, thus permitting a greater number of cooling fins in close contact with the head of the cylinder. But experiments have still to be made for determining the relative merits of size, shape and number of cooling fins, in connection with cylinder diameters and high compression-ratios before a definite conclusion as to the practical limit and size of the air-cooled radial-type engine can be reached.

Air-Cooled versus Water-Cooled Engines

The result of all these experiments on air-cooled cylinders covering a period of years has brought the art to such a point that air-cooled engines of approximately 25 hp. per cylinder are being produced commercially that have the same performance ability as the best water-cooled engines. This can be established by a comparison of the performance of an air-cooled engine and a water-cooled engine of approximately the same power. We will take for comparison a typical water-cooled V-type eight-cylinder engine and the Lawrance Model-J, nine-cylinder air-cooled engine. In neither case is the horsepower the maximum that can be or has been obtained; it is the average horsepower likely to be obtained in service. Table 2 shows this comparison.

It will be noticed that there is very little difference between these engines. The fuel consumption of the water-cooled engine is lower than that of the radial air-cooled engine on account of the higher compression-ratio of the former. Both engines can show a considerably lower consumption if regulated for this, of course; however, this is at the expense of the horsepower.

Including 68 lb. for a radiator and 76 lb. for water, the weight of the water-cooled engine is 621 lb.; the air-cooled engine weighs 426 lb. complete. This saving is due to the air-cooling and the more compact arrangement of the radial engine. Experience with air-cooled cylinders of this type has shown that it is possible to increase the compression-ratio to the same extent as in water-cooled engines, and that a fuel consumption equaling the best performance of water-cooled types can be obtained. Tests of a three-cylinder engine having a volume of 75 cu. in. per cylinder and a compression-ratio of 6.2 to 1, using one-half benzol and one-half aviation gasoline and regulated for a minimum consumption, have shown a fuel consumption as low as 0.43 lb. per b.hp-hr. with a brake mean effective pressure of about 130 lb. per sq. in.

TABLE 2—COMPARATIVE PERFORMANCE OF AIR AND WATER-COOLED ENGINES

Method of Cooling	Water	Air
Speed, r.p.m.	1,800	1,800
Rating, hp.	200	220
Cylinder Volume, cu. in.	716	787
Brake Mean Effective Pressure, lb. per sq. in.	122	123
Fuel Consumption, lb. per b. hp-hr.	0.48	0.51
Compression-Ratio	5.3 to 1	5.0 to 1

The data given show the present state of the art for small engines but, in view of the interesting work that is being carried on at McCook Field and elsewhere, I believe that before the end of 1922 air-cooled engines developing up to 50 hp. per cylinder will be showing as good, if not better, performances than water-cooled engines of the same volume.

In connection with the development of large air-cooled engines, the question of cylinder temperatures and the difference in temperature between the front and rear of the cylinder as affected by the design and the choice of material becomes of great importance. It is obvious that the side exposed to the airblast has a better chance of cooling than the side not so exposed, and it is desirable that the cylinder circumference should be equally cooled.

Progress in Engine Cooling

The great progress achieved in air-cooled development is largely due to the use of aluminum for cylinder and head construction. Not only has this material a conductivity much greater than that of cast iron or steel but, on account of its light weight, thicker sections can be used, permitting a very rapid flow of heat from points that are not exposed to a proper air flow. Its greater conductivity also allows the efficient use of cooling fins as deep as foundry practice will permit. Hot-spots are avoided in this way and more cooling surface is provided than in the case of cylinders constructed of iron or steel.

We have definite data as to the actual temperatures existing in an air-cooled cylinder of very high output, that are presented in Fig. 13. The cylinder was built by the Airco Co. in England and was tested in November 1919. It is of the roof-head type with four valves per cylinder, having a 5.5-in. bore and a 6-in. stroke. The design shown in Fig. 13 is conventionalized and does not attempt to give the true proportions of this cylinder. This engine ran at 1700 r.p.m. in a mean airblast of 87 m.p.h. and developed 42.2 b.hp., which gives a brake mean effective pressure of 138.2 lb. per sq. in., the fuel consumption varying from 0.600 to 0.565 lb. per b.hp-hr. All temperatures are in degrees fahrenheit. It will be noticed that the hottest point on the cylinder was in the head between the exhaust-valves, as would be expected, with a temperature of 516 deg. fahr. The temperature decreases at the edge of the combustion-chamber wall to 383 at the rear end to 367 deg. fahr. at the front, a difference of only 16 degrees. This small difference that exists nowhere else might be accounted for by the cooling action of the inlet-ports, but readings on each side at the same plane, not shown in Fig. 13, give a temperature of only 354 deg. fahr., or somewhat less than those at the front.

The most plausible explanation of this small temperature-difference is that the airflow around the corner of the head and combustion-chamber wall is very efficient. The maximum temperature-difference between front and rear on the aluminum head is only 94 deg. fahr., which is not serious. The temperature is less on the lower portion of the cylinder, but the difference between front and rear is much greater, with a maximum of 187 deg. fahr. This is to be expected in view of the poor conductivity of the cylinder material and the thinness of the cylinder

walls. The temperature is higher at the foot of the cylinder, which is probably due to heat transmitted from the crankcase.

Tests of the same cylinder at air speeds as low as 45 m.p.h. did not show any tendency to produce hot-spots on the rear of the cylinder. The entire temperature increased both front and rear with a smaller difference between front and rear than existed at higher air-velocities, and with a corresponding decrease of power and an increase in the fuel consumption. The brake mean effective pressure developed by this cylinder is equal to the best water-cooled practice, which may be surprising to many in view of the fact that the cylinder-wall temperatures are apparently much higher than those prevailing in water-cooled cylinders, on the assumption that these do not exceed the boiling temperature of the water that surrounds them. However, this is not the case. Tests on a Hispano-Suiza engine showed a maximum temperature on the outside of the top of the cylinder wall of 470 deg. fahr. In other words, the temperature of the cylinder walls of water and air-cooled engines are not much different.

The cylinder of the water-cooled engine is covered in part with a film of steam. Small areas of steam are formed, which are instantly swept away by the rapid flow of water and recondensed by the water that has not yet come in contact with the cylinder wall. The rapid flow of water and the formation of small areas of steam produce a state of extreme turbulence culminating at the cylinder-head. This does not produce any steam in the radiator return-pipe, provided the velocity of flow and the capacity of the water-jacket at the hottest points are

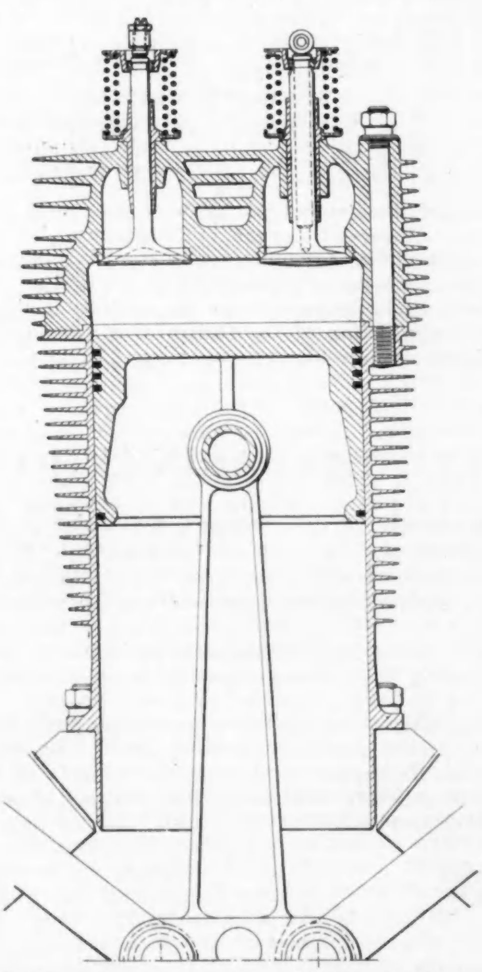


Fig. 12—Cylinder of the Lawrance 350-Hp. Air-Cooled Engine

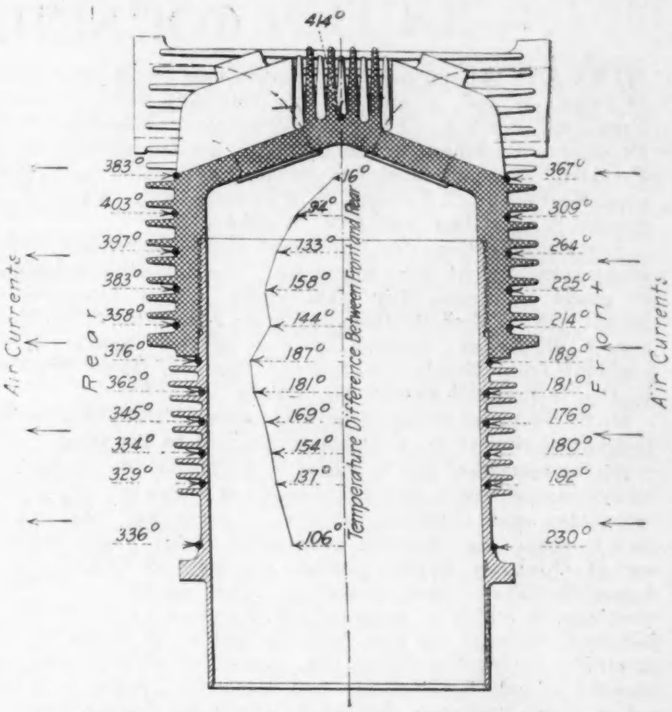


Fig. 13—Temperature Differences in Degrees Fahrenheit between the Front and Rear of an Air-Cooled Cylinder

adequate. The water-cooled engine is handicapped by the number of heat transfers required from one conductor to another, all of which tend to increase the ultimate temperature on the inside of the cylinder wall. The minimum number of heat transfers is three. They are (*a*) from the cylinder to the water, (*b*) from the water to the inside of the radiator core and (*c*) from the outside of the radiator to the air.

Engine-Cooling Factors

In some efficient engines like the Wright Hispano we have an additional transfer of heat, from the steel cylinder to the aluminum cylinder. In air-cooled engines the transfer is direct to the air; in the case of the combustion-chamber, and in an aluminum cylinder with steel liner, through only one additional step, it is from liner to cylinder. In the most efficient air-cooled cylinders, as shown in Figs. 11 and 13, the flow of heat to the air is the most direct that can be obtained. The water-cooled engine is handicapped also by the use of a medium that boils at 212 deg. fahr. It must be held at a certain margin of safety below this.

Let us assume in one case that the air at 60 deg. fahr. strikes a radiator having an average temperature of 180 deg., a temperature difference of 120 deg. between the air and the object to be cooled. Let us assume also that the air at 60 deg. strikes a cylinder having an average temperature of 300 deg., a difference of 240 deg. If everything were equal, air velocity, freedom of airflow, efficiency of airflow, coefficient of radiation of the two objects and the like, the cooling per unit area would be proportional to the difference in temperature of the air striking and of the air leaving the object to be cooled. In this case the cooling effect per unit for the air-cooled cylinder would be approximately 1½ to 1¾ times that of the radiator, because the cylinder temperature is nearly twice as great as the average hot-water temperature of the radiator. However, the conditions are different

(*Concluded on page* 144)

COUNCIL MEETINGS

THE 1921 Council held the last sessions of its administration on Jan. 9 and 10, the following being present: President Beecroft, First Vice-President Horning, Vice-Presidents Bachman, Crane, Johnston and VanBlerck, Past-President Vincent, Councilors Brush, Davis and Pope, Treasurer Whittelsey, C. F. Scott, O. W. Young, F. E. Watts, C. B. Segner, V. E. Clark and J. V. Whitbeck.

Forty applications for individual membership and 17 for student enrollment were approved. The following transfers in grade of membership were made: From Associate to Member, A. C. Ziebell; from Junior to Associate, A. C. Bigelow, A. R. Keagy; from Member to Service Member, I. M. Laddon; from Member to Foreign Member, David Flather, G. D. Flather and Kenske Hashimoto.

B. B. Bachman resigned as a member of the Constitution Committee and C. B. Veal was appointed in his stead.

At the request of its chairman, F. W. Davis, the Committee on Science of Truck Operation was discontinued. When the committee was organized nearly 2 years ago the intent was to study the economic adaptation of the motor vehicle and the highway, outline certain problems of research and formulate data in that connection. The committee held two meetings at which a program for development of the subject was outlined. At that time the Bureau of Public Roads started a research program on impact of motor trucks on highways, and the Highway and Highway Transport Education Committee was formed to carry on related investigations. Since that time the National Research Council has instituted a complete program of research on road resistance, tractive resistance and general economic development of highways, and work on the two first subjects is under way at the Massachusetts Institute of Technology. Dr. Dickinson, of the Research Department of the Society, is assisting in this. It was felt under the circumstances that the best thing to do was to discontinue the Committee, as stated.

Mr. Davis was appointed as an additional representative of the Society on the Engineering Division of the National Research Council.

At the session of the Council held on Jan. 10 Chairman Bachman, of the Standards Committee, reported in detail the action taken by that committee on the same day with regard to proposals of 16 of its Divisions as set forth elsewhere in this issue of THE JOURNAL. The proceedings of the Standards Committee were approved for submission to the Society in meeting assembled on Jan. 11, for consideration in the matter of referring the recommendations of the Divisions by letter ballot to the voting members of the Society for final adoption.

ORGANIZATION SESSION OF 1922 COUNCIL

The organization session of the 1922 Council was attended by President Bachman, First Vice-President Whitbeck, Vice-Presidents Clark, Young and Watts, Past-President Beecroft and Councilors Crane, Davis and Scott.

President Bachman announced the personnel of the 1922 Administrative Committees as follows:

CONSTITUTION COMMITTEE

N. B. Pope, *Chairman*

C. B. Veal W. A. Brush

FINANCE COMMITTEE

H. M. Swetland, *Chairman*

H. L. Horning C. B. Whittelsey
Russell Huff O. W. Young

HOUSE COMMITTEE

F. E. Moskovics, *Chairman*

C. F. Kettering C. B. Veal
F. S. Slocum J. V. Whitbeck

MEETINGS COMMITTEE

C. F. Scott, *Chairman*

J. R. Cautley Orrel A. Parker
M. C. Horine B. S. Pfeiffer
M. P. Rumney

MEMBERSHIP COMMITTEE

Lon R. Smith, *Chairman*

J. R. Coleman R. E. Northway
G. P. Dorris A. M. Wolf

PUBLICATION COMMITTEE

Daniel Roesch, *Chairman*

O. C. Berry D. L. Gallup
F. W. Caldwell O. B. Zimmerman

SECTIONS COMMITTEE

A. K. Brumbaugh, *Chairman*

H. R. Corse R. J. Nightingale
G. E. Goddard H. W. Slauson

President Bachman reported also the names of the members who will serve this year as Chairmen and Vice-Chairmen of the Standards Committee and its Divisions. These are listed in this issue of THE JOURNAL, as well as those named by the Council for service on the various Divisions.

The next meeting of the Council was scheduled to be held in Chicago on Jan. 31.

BRITISH AUTOMOTIVE VEHICLE STANDARDIZATION

A FURTHER step in the movement toward the standardization of automobile, motorcycle and cycle parts has been taken by the British Engineering Standards Association in the formation of seven subcommittees to undertake the following sections of the work:

(1) Nomenclature, Major C. Wheeler, *chairman*
(2) Steels, A. A. Remington, *chairman*
(3) Small Fittings, W. D. Williamson, *chairman*
(4) Electrical Fittings, E. Garton, *chairman*
(5) Shafts and Shaft Details, L. A. Legros, *chairman*
(6) Wheels, Rims and Tires, Lieut.-Col. D. J. Smith, *chairman*
(7) Cast Iron, Dr. L. Aitchison, *chairman*

A conference of the chairmen, presided over by H. C. B. Underdown, the chairman of the Sectional Committee, was held recently, at which the personnel of each of the subcommittees was very carefully gone into and provisionally agreed upon.

Before the subcommittees actually embark upon the detailed work, the various organizations concerned are being consulted to insure that the proposed personnel meets with their approval as adequately representing their respective interests. In the meantime, in order not to delay matters, technical data in regard to the specific subjects to be taken in hand immediately are being collected. — *Cooper's Vehicle Monthly* (London).

S A E

INTERCHANGEABLE MANUFACTURE

NO two things are alike. The difficulty of maintaining accuracy increases in geometric ratio with each added accurate dimension on the same piece. No machine or tool under stress can be accurate. The manufacture of interchangeable parts in quantity is a matter of percentage. Irrespective of the method used, quality is a matter of insistence.

The nearest approach to mechanical perfection that we know of is found in the Johansson gages, or was until the advent of the Hoke gages; but, within their limits, these are not interchangeable and the interferometer shows not only a variation in size but also a difference in parallelism of the same piece.

Securing one very accurate dimension on a piece is a comparatively simple matter. The ease of securing two accurate dimensions, however, depends upon the relation of the second to the first. The figures given in Table 1 are based upon practice and general impressions, but are believed to be accurate enough to justify their publication for the purpose of showing the high cost of unnecessary accuracy:

TABLE 1—RELATION BETWEEN INCREASE IN NUMBER OF DIMENSIONS AND NUMBER OF PERFECT PIECES

Number of Dimensions on One Piece	Probable Number of Perfect Pieces	Estimated Increase in Cost per Operation, per cent
1	100	0
2	90	30
3	50	75
4	15	100
5	5	200
6	0	500

In making the foregoing statements I have in mind automatic and other machines where the close-dimension work is done at one setting and in manufacturing quantities. Some will dispute the figures given in the table and declare that it is not good practice to attempt finishing pieces in the automatic, but that they should be roughed-out there and finished on a shaving lathe or elsewhere. Why should they not be finished complete when a good automatic must, in the nature of things, be, and is, as accurate as a single-purpose machine on a single accurate dimension? It is not accurate on several close ones, however, and accepted practice confirms this statement, and the reason it is not, and cannot be, accurate is the conflicting stresses.

There are many firms the engineering department of which really believe they are producing an interchangeable product of close dimensions, but their inspection and manufacturing departments could tell a different story. It is not bad workmanship or lax inspection that is responsible for their failure to produce such work, but the oft-times unnecessarily close tolerances specified on unimportant dimensions, or the insistence of close ones on several dimensions of the same piece, and it is well to stop and consider what may happen, say, to a piece of apparatus after it has been in service for some time when initially it required the centers of two shafts to be held within 0.0005 in. Interchangeable manufacture requires both relative and specific tolerance. Relative tolerance has to do with its relation to the part to which it assembles, and does not necessarily affect the tolerance of the specific dimension. Specific tolerance is that tolerance on a specific dimension required to render a particular part easy to manufacture, or to take care of the wear on tools.

Any part increases in cost with each succeeding operation, and the probability of loss should decrease in the ratio of its added value. This result should be obtained, first, by a design having in view its relation to subsequent machining operations, and, second, through the proper sequence of operations relative to their difficulty, and sufficiently divided. This leads us up to the question of registration. Automobile engine-builders cast lugs on their cylinders to insure parallelism of the bore; adding-machine and phonograph castings sometimes have bosses cast on, to take the pressure of milling or drilling operations. It is also true that sometimes we insert a pin in a drilled hole to guard against movement, but we do this only at times and usually as a matter of convenience, whereas it is a matter of necessity, and it will usually cost less to drill special holes or machine special lugs for registration and resetting than to attempt to do the work in fewer complex operations.

Nearly as important as registration is the question of clamping. One of the fundamentals laid down was that a machine under stress could not be accurate. This is just as true of a piece being machined, and unless a part is designed with its subsequent machining operations in view; unless it is supported sufficiently near its pressure centers; unless it has a three-point support with the holding or clamping pieces immediately over them, and in the case of a drill jig, independent of the part that carries the bushings, then that piece cannot be accurate. This is true of drilling always, of milling generally and of turning sometimes.

How shall tolerances be indicated; shall they be identical, independent, or overlapping; what does the law of probability and actual trial demonstrate as the probability of overlapping or identical tolerances interfering; what percentage may be expected at different parts of the tolerance, and the lessons to be learned therefrom, are subjects calling for extended treatment by themselves. The same is true of inspection, machining methods and analysis of the product.

The automatic screw-machine will, of course, always be with us, for in that we meet ideal manufacturing conditions as nearly as they can be met. But the fact that the single-spindle screw-machine persists and is even exclusive in the small-part field is still further corroboration of the price we must pay for accuracy. The question of accuracy is, of course, relative, as is the question of the rigidity of the machine; but it is important in its bearing upon the cheapness of manufacture by determining the number of cuts, retapping, reaming, grinding, and the like, that are necessary.

The law of compensation applies to mechanics as well as elsewhere in industry, and when we attempt to work to closer limits at the expense of increased operations, we must pay somehow. This is not to be considered as an argument against such a procedure, but an appeal for commonsense in interchangeable manufacture, not to make the work easier, but to reduce the cost, and the firms that are really making a good interchangeable product are those that have analyzed all the different conditions and hold the extremely accurate dimensions at a minimum. Neither should it be thought from what has been said that close dimensions may not be necessary or desirable. Some companies require them much closer than do others. It then becomes a question of whether the price received for the finished apparatus is commensurate with the close limits imposed. If not, it is a matter of increasing the tolerances so as to permit manufacture on a cheaper basis. In other words, the percentage of rejections that can be tolerated must be figured out and kept within that limit. For instance, on an apparatus costing $10, for which a liberal price is asked and received, an allowance of 50 cents per apparatus for rejections may not be excessive. If, on the other hand, the price is close, 50 cents may mean the difference between profit and loss. This is a matter of policy to be settled by the administration and not by the shop, although we very often lose sight of this fact.

In my opinion, there are no such things as close tolerances. All are relative, and we only court trouble when we try to take too many steps at once. One-half thousandth is only 5 per cent of 0.0001 and the chance of securing that accuracy in quantity in one step is about 5 per cent multiplied by the extra cost. But 0.0005 is 50 per cent of 0.0010 and the probabilities are increased in the same ratio. So we may lay it down as a truism that subdivided operations are a function of accuracy.

Analyzing our fundamentals, we find that the three ways in which interchangeable parts can be secured are by:

(1) Obtaining a percentage of good ones, with close tolerances
(2) By giving individual attention to each piece
(3) By employing liberal allowances

The first way is wasteful; the second is not manufacturing; the third means liberal unnecessary allowances and close necessary ones, with the operations divided so that each individual working upon the part has but one thing to do. Thus, on a small shaft with six diameters all ground to a 0.0005-in. limit, there should be six roughing and six finishing operations, because (*a*) different wheels may be used; (*b*) less skilled men may be employed with less chance of scrap; (*c*) the wheel will be in better condition and will not need dressing so often and the operator will not have to change his sense of proportion, "hog off" material one moment and hardly touch it the next; (*d*) the finishing operations may always be done on the most accurate machine; and (*e*) last, but not least, as a rule a single machine operator can finish more work to close dimensions in four operations than four different machinists who possess the same average ability can in one operation.—C. B. Lord before American Society of Mechanical Engineers.

AIR-COOLED ENGINE DEVELOPMENT

(*Concluded from page* 141)

in that the airflow through the radiator is restricted, due to the length of the tubes to be traversed, the inefficient shape of the entrance and outlet of each tube and the restriction back of the radiator which is often very great. In the case of the cylinder, the fins offer less resistance to the air because they are comparatively shallow and tapered, and the propeller pulsations produce a condition of turbulence back of the cylinder that carries away the air located behind it. It will be seen that, although it is not possible to arrive at any definite figures, the cooling of the cylinder per square foot of area is much more efficient than that of the radiator per square foot of area; hence the need for much less radiating surface to produce the same result.

At present data are not available to determine the comparative resistance of the two types installed in similar airplanes, but it is hoped that the necessary information will become available during this year. However, it is fair to state that, since the use of radial air-cooled engines is in its infancy, much better methods of installing and cowling these engines will be developed. An example of work along these lines is the wind-tunnel test of a British airplane, the Westland Weasel, a small pursuit plane equipped with an A. B. C. Dragonfly engine having a diameter of nearly 49 in. The tests were made at a velocity of 100 ft. per sec. The resistance of the fuselage without the cylinders and with the cylinder openings faired is 0.270 lb.; with the cylinders in place it is 0.616 and with crusader cowls 0.444 lb.

The crusader cowl is a form of cowl attached to the head of each cylinder and somewhat resembling a helmet of the type having a small visor and a curved-up portion at the rear for the protection of the neck. The fuselage resistance is increased 128 per cent by the addition of the cylinders, but is increased only 65 per cent with the use of the cowls. The fuselage without cylinders is nothing but a round-section streamlined body and it is reasonable to believe that the addition of any water-cooled engine of equal power, with radiators and the like, would have caused considerable increase in the amount of the resistance to the passage of the aircraft through the air.

Another possible method of installing air-cooled engines is that of completely enclosing the engine in a cowl. The Smith engine, developed some years ago, was completely enclosed and provided for cooling the cylinders not only at the front but at the back, taking the air from an opening around the propeller-hub. When tested at McCook Field, an engine of this type showed very good cooling. On airplanes other than those of the pursuit type, in which the engine is out of all proportion to the size of the plane, such an installation should be possible and enable us to obtain the low fuselage resistance of the water-cooled-engine ship, with the admitted advantages of the air-cooled engine.

THOMPSON AUTORIFLE

(*Concluded from page* 134)

the advantages of semi-automatic fire in battle are not fully conceded by all military experts. Rapidity of fire, however, has been one of the most important considerations affecting the design of small arms since time immemorial.

Probably no tradition of our Army is cherished so dearly as the proverbial markmanship of the American soldier. This tradition has been fostered by most careful training methods to such an extent that it is seldom, if ever, that an American rifle team is defeated in international competition. The degree of proficiency obtained by American Army training methods with the enlarged forces involved in the war, was certainly successful in that the American soldier, as a rule, was superior in marksmanship to his allied comrades in arms, and equal to at least the best trained enemy forces. With the advances made during the last century in the application of the principle of replacing man-power by machine-power, the advent of automatic fire in replacing hand-loaded fire cannot be far distant. If, to hold a position that is opposed by isolated units of automatic fire, it is necessary to concentrate thickly marksmen using hand-loaded weapons for the purpose of maintaining fire superiority, many believe our world-war experience has shown us that the price is paid in blood.

ADVANTAGES OF AUTOMATIC-RIFLE FIRING

At the critical moment that occurs in every battle, other things being equal, the side that brings the preponderance of lead to bear will be victorious. If, by the adoption of a semi-automatic shoulder rifle it is made possible for the soldier to deliver at the critical moment 40 aimed shots per minute against the soldier who with his hand-loaded weapon fires 20, the result can be surmised.

However, in the past, the semi-automatic shoulder rifle weighing under 10 lb. and firing the high-powered military cartridge has not only proved unreliable in action, but totally unable to endure the many rigors required of it. If the self-acting lock is an answer to the many problems involved, the prestige of the American gun engineer will move one step above the stage to which it has been raised throughout each decade by such inventors as Hall, Maynard, Henry, Sharp, Rider, Lewis and Browning.—Col. H. E. Hartney in *Army Ordnance*.

ACTIVITIES OF THE SECTIONS

Secretaries of the Sections

BUFFALO SECTION—C. A. Criqui, Chairman, Sterling Engine Co., Buffalo
CLEVELAND SECTION—E. W. Weaver, 5103 Euclid Avenue, Cleveland
DAYTON SECTION—R. B. May, Dayton Engineering Laboratories Co., Dayton, Ohio
DETROIT SECTION—B. Brede, assistant secretary, 1361 Book Building, Detroit
INDIANA SECTION—B. F. Kelly, Weidely Motors Co., Indianapolis
METROPOLITAN SECTION—F. E. McKone, 347 Madison Avenue, New York City
MID-WEST SECTION—T. Milton, 140 South Dearborn Street, Chicago
MINNEAPOLIS SECTION—C. T. Stevens, Reinhard Brothers Co., Minneapolis
NEW ENGLAND SECTION—H. E. Morton, B. F. Sturtevant Co., Hyde Park, Boston
PENNSYLVANIA SECTION—T. F. Cullen, Chilton Co., Market and 49th Streets, Philadelphia
WASHINGTON SECTION—B. R. Newcomb, 211 Victor Building, City of Washington

AT the invitation of the Burlington, Vt., Chamber of Commerce, President Beecroft gave an address on commercial aviation before that body on Jan. 4.

At the Washington Section meeting on Jan. 6 an account of the remarkable regularity of the Air Mail Service was given. The speakers were Second Assistant Postmaster General E. H. Shaughnessy, C. L. Egge, general superintendent of the Air Mail Service, and Major H. W. Harms.

The Metropolitan Section joined the local section of the American Society of Mechanical Engineers in a meeting on Jan. 17, at the Engineering Societies Building. P. L. Battey gave a paper on the design of a plant for the production of automobiles on the progressive-assembly plan.

The Buffalo Section on Jan. 17 heard with interest Prof. F. O. Ellenwood talk on Pneumatic Truck Tire Temperatures. He had spent some months in devising instruments for measuring these temperatures to obtain data on the origin and radiation of heat in tires. On Jan. 24 Major L. B. Lent, formerly general superintendent of the Air Mail Service, gave one of the best papers of the entire aviation series before the members of the Buffalo Section. His cost analysis of the Air Mail Service was of extreme interest.

C. H. Norton gave a paper on grinding machines and processes before the New England Section at the Boston Engineers Club on Jan. 20.

R. W. Daniels spoke on Duralumin at the Cleveland Section meeting on Jan. 20. This remarkable alloy is of practical interest at this time because of its growing use in the aviation industry.

COMING AVIATION SESSIONS

It is the intention of the members of the Society located in Cincinnati to hold an aviation meeting early in February, probably on Feb. 2. Invitations will be issued to the local section of the American Society of Mechanical Engineers, the Chamber of Commerce and other organizations to join with the members of the Society in this meeting.

San Francisco, while not having a regularly constituted Section of the Society, has a live local committee, headed by Frank B. Drake, which has arranged some interesting meetings for the members of the Society in that territory. This committee has planned to have a speaker on commercial aviation and to show the moving pictures of the bombing of ex-German war vessels by aircraft at a meeting on Feb. 16. It is expected that the Los Angeles and the Seattle groups will hold similar meetings during the month of February.

ANNUAL REPORT OF THE SECTIONS COMMITTEE

At the Summer Meeting of the Society held at West Baden last May the Sections Committee made the proposal that a strong effort be made by the Program Committee of each Section to arrange its schedule of meetings for the ensuing year well in advance. It was believed that with proper attention the dates of meetings could be fixed for the entire year and that the full program of subjects to be treated could be outlined at

Schedule of Sections Meetings

FEBRUARY

3—WASHINGTON SECTION
3—MID-WEST SECTION—Modern Ideas About the Nature of Matter—Address by Prof. H. B. Lemon
8—MINNEAPOLIS SECTION—Road-Building Machinery and Engineering
10—NEW ENGLAND SECTION—Isolated Lighting Plant Meeting at Boston or Worcester—Paper by Mr. Wilkins, of the H. C. Dodge Co.
16—SAN FRANCISCO—Aviation Meeting
21—BUFFALO SECTION—Resilient Wheels—Paper by A. C. Vauclain
21—METROPOLITAN SECTION—Motorboat Meeting
23—PENNSYLVANIA SECTION—Current Business Conditions and the Engineer's Place in Commercial Development
24—DETROIT SECTION—Light-Weight Pistons and Piston-Rings—Paper by F. Jehle and F. Jardine

MARCH

7—DAYTON SECTION—Recent Developments in Water-Cooling—Paper by L. L. Snow
10—NEW ENGLAND SECTION—Business Aspects of the Automotive Industry
16—METROPOLITAN SECTION
21—BUFFALO SECTION—Electric Wiring Systems—Paper by W. S. Haggott
23—PENNSYLVANIA SECTION—Batteries and Electrical Equipment. Also paper by J. M. Teasdale
24—DETROIT SECTION
31—MID-WEST SECTION—Various Commercial Fuels and Their Relative Characteristics

the beginning of the season. It was thought also that in a great many cases it would be possible to schedule the desired speakers a number of months in advance of the presentation of their papers. The Sections Committee believed that such activity on the part of the Program Committees would result in better papers and larger audiences.

In the Sections that followed this suggested procedure the results have been highly satisfactory. By notifying the Section members well in advance of the dates and subjects of meetings throughout the year, a larger attendance has been secured, and by allowing speakers sufficient time for preparation better papers have been presented. It is recommended that all of the Sections fix the dates, select the subjects and, so far as possible, arrange for the speakers at once for the rest of their season, if this has not already been done.

At the Sections luncheon at West Baden the suggestion was made that extension meetings be held from time to time in cities where no Sections are established. Another idea was that one month of the year be devoted to the special consideration of the status of Commercial Aviation. Accordingly, Aviation meetings have been held or will be held shortly at Boston, Buffalo, Cleveland, Detroit, Indianapolis, New York City, Chicago, Philadelphia, City of Washington, St. Louis, Burlington, Vt., San Francisco, Los Angeles, and Seattle. Speakers for these meetings were selected not only from the membership of the Society but from the personnel of various organizations engaged in aviation, including the War, Navy and Post-Office Departments. A large amount of information was brought out showing the progress that has been made recently in commercial aviation, and consideration was given to the retarding influences that are now acting against more rapid development in this field. The attendance at the meetings was in general over twice the normal attendance at Sections Meetings. There was a considerable amount of newspaper publicity in connection with them. It is believed that the meetings were of real assistance to the aviation industry in acquainting the public with the truth of the present situation as it affects that particular branch of the automotive industry.

In a number of the cities at which Sections of the Society are located discussion has been had as to the desirability of some sort of affiliation between sections and the respective local engineering societies or clubs. The Sections Committee has kept in touch with these developments, considering each case on its merits, and recommended in some instances a form of affiliation.

The Committee feels that the Sections have cooperated with it in an admirable manner, and trusts that they will maintain close contact, through the office of the Society, with the 1922 Sections Committee.—(Signed) Hugh R. Corse, Chairman of the Sections Committee.

OBITUARY

CLARENCE E. ROGERS, chief engineer of the Huffman Bros. Motor Co., died at his home in Elkhart, Ind., Dec. 18, 1921, aged 36 years. He was born in St. Joseph County, Ind., on Sept. 23, 1885, and was graduated from the local grammar school in 1901. His other education was a correspondence course in mechanical engineering that he completed in 1905.

Mr. Rogers' business experience began in November, 1905, with his entrance into the service of the Dodge Mfg. Co., Mishawaka, Ind., as a machine operator, where he remained until March, 1907, when he became associated with the Amplex Motor Car Co., also of Mishawaka, as a tracer and detailer on automobile work. In October, 1909, he accepted a position with the Advance-Rumely Co. at Laporte, Ind., where he was engaged in detail and layout work on Oil Pull combustion engines for approximately 2 years. He subsequently accepted a position as chief draftsman with the Wire Specialty Co., South Bend, Ind., and was engaged on special wire forming machinery, afterward becoming foreman of the experimental department, where he designed wire and bending machines. From April, 1913, to July, 1915, Mr. Rogers was assistant chief draftsman with the Western Electric Co. at Chicago, where he developed special equipment for telephone exchanges.

With the exception of 1 year, Mr. Rogers' connections since January, 1916, have been with the automotive industry in the vicinity of Elkhart, Ind. He was chief draftsman and assistant production engineer with the Sun Motor Car Co. for approximately 15 months when he entered the service of the Crow Motor Car Co. as chief inspector. From June to September of 1917 he was engaged as a tool and jig designer by the Foster Machine Co. In September, 1917, Mr. Rogers was compelled to relinquish this position on account of poor health and for a year was a salesman for the Aluminum Cooking Utensil Co. of New Kensington, Pa. In October, 1918, he was appointed chief engineer of the Huffman Bros. Motor Co., a position that he held continuously until the time of his death. Mr. Rogers was elected to Member grade in the Society, Dec. 10, 1919. His widow survives him.

THE WIND-TUNNEL

THE wind-tunnel, established for the purpose of aeronautical instruction, opens a wide field for scientific research. The fundamental laws of fluid dynamics are still in the elementary stage and require empirical research of a highly specialized nature.

There are many applications of wind-tunnel work outside the confinements of mechanical flight. The Government wind-tunnel sections receive inquiries of divers nature from blower companies, ventilation engineers, fan manufacturers, windmill designers and designers of wind-bracing; in fact from all the older branches of engineering wherein the phenomena of fluid dynamics play a part. Examples are: tests on the wind resistance of roofs and buildings, the windage of battleships, the heat conduction of radiators due to air-flow, the calibration of flowmeters, the action of ventilating apparatus, the design of blowers and fans, the nature of the meteorological movements of the wind, the nature of the flow of gases in pipes and the question of noise propagation in the air by ventilation apparatus.

Without the wind-tunnel there is no way to find out precisely what the air does in any given application. Suppose, for example, a blower manufacturer suspects he can improve the efficiency of his product, perhaps by changing the shape of the impeller vanes. In the past he availed himself of the cut-and-try method, making up one after another full-sized impeller wheel until satisfactory results were obtained. Today he can go to the wind-tunnel, secure tests on small models of isolated blades, and from the coefficients thus determined design his machine with full assurance of success. Wind-tunnel coefficients have been found to apply with great success to the case of rotary blowers.—E. N. Fales and F. W. Caldwell in *Aerial Age Weekly*.

Applicants *Qualified*

The following applicants have qualified for admission to the Society between Dec. 10, 1921, and Jan. 10, 1922. The various grades of membership are indicated by (M) Member; (A) Associate Member; (J) Junior; (Aff) Affiliate; (S M) Service Member; (F M) Foreign Member; (E S) Enrolled Student.

ARROW, PERCY JOHN (A) technical salesman, Associated Equipment Co., Ltd., Walthamstow, London, E. 17, (mail) 12a Clarendon Road, Putney, *London, S. W. 15, England.*

BACKUS, HAROLD A. (M) chief inspector and metallurgist, Gallaudet Aircraft Corporation, *East Greenwich, R. I.*

BAUMAN, JOHN NEVIN (E S) student, University of Michigan, *Ann Arbor, Mich.*, (mail) 1109 Prospect Street.

BOCK, OSCAR LOUIS (E S) Iowa State College, *Ames, Iowa*, (mail) 2116 Lincoln Way.

BORRESON, HARRY (A) foreman of practical test laboratory, American Bosch Magneto Corporation, 520 North Main Street, *Springfield, Mass.*

CARLSON, R. E. (S M) chief of tank section, tank, tractor and trailer division, Chief of Ordnance, *City of Washington.*

CLINE, EARL E. (M) Ernest Holmes Co., *Chattanooga, Tenn.*, (mail) 867 McCallie Avenue.

COBURN, H. H. (M) Wellesley School Department, (mail) 320 Washington Street, *Wellesley Hills, Mass.*

DIEDERICHS, H. (M) director of school of engineering, Cornell University, *Ithaca, N. Y.*

EASTMAN, EDWARD H. (E S) student, Iowa State College, *Ames, Iowa*, (mail) 203 Welch Avenue.

FISHER, CARL HERBERT (A) assistant service manager, General Motors, Ltd., London, S. W. 7, (mail) 24 Minet Avenue, *Harlesden, London, N. W. 10.*

FITZPATRICK, JAMES R. (M) secretary, Haskelite Mfg. Corporation, 133 West Washington Street, *Chicago.*

FLORO, MARTINIANO (E S) student, University of Illinois, Urbana, Ill., (mail) P. O. Box 563, Station A., *Champaign, Ill.*

GANSTER, LOUIS T. (A) president and secretary, Berks Auto-Ignition Co., 514 Cherry Street, *Reading, Pa.*

GLENN, JOHN W. (A) president and general manager, Glenmore Co., Inc., 169 Delaware Avenue, *Buffalo.*

GOOD, CHARLES WINFRED (M) instructor, University of Michigan, *Ann Arbor, Mich.*, (mail) 1014 Cornwell Place.

HART, RICHARD LECKLIDER (E S) student, University of Michigan, *Ann Arbor, Mich.*, (mail) 408 East Washington Street.

HOWELL, K. J. (J) 802 Ocean Avenue, *New London, Conn.*

JOHNSON, CARL A. (M) sales engineer, Hyatt Roller Bearing Co., Chicago, (mail) R. F. D. 9, Box 153, *Muncie, Ind.*

KIRKPATRICK, WILLIAM J. (A) assistant service manager, A. Schrader's Son, Inc., *Brooklyn, N. Y.*, (mail) 470 Vanderbilt Avenue.

LA HATTE, MILNER T. (A) manager and engineer, Southern division, Selden Truck Corporation, Rochester, N. Y., (mail) 322 Peachtree Street, *Atlanta, Ga.*

LOVEJOY, RALPH M. (A) president, Lovejoy Mfg. Co., 39 Brighton Avenue, *Boston.*

MCLERIE, A. G. (A) officers' mess, Canadian Air Force, *Camp Borden, Ont., Canada.*

MILLER, HOWARD A. (J) junior partner, Automotive Service Co., 295 Plymouth Avenue, South Rochester, N. Y.

PARKS, CHARLES (A) president and sales manager, Parks-Campbell-Finley Motor Co., *Oklahoma City, Okla.*, (mail) 2410 Classen Boulevard.

PARR, C. H. (M) engineer, Hart-Parr Co., *Charles City, Iowa*, (mail) 100 Hulin Street.

RAYCROFT, LOUIS B. F. (A) manager, Boston service depot, Electric Storage Battery Co., Philadelphia, (mail) 720 Beacon Street, Boston.

RIPLEY, JOSEPH P. (M) general manager, Brewster & Co., Queens Plaza, *Long Island City, N. Y.*

ROEMER, ARTHUR (M) designer, Hupp Motor Car Corporation, *Detroit*, (mail) 2579 Field Avenue.

SACKETT, A. H. (A) service manager, Elgin Motor Car Corporation, *Chicago*, (mail) 5221 Drexel Avenue.

SCHILLING, C. A. (A) chief inspector, Yuba Mfg. Co., *Benicia, Cal.*, (mail) P. O. Box 856.

SEISS, GEORGE J. (A) president, chief designer and estimator, Seiss Mfg. Co., 3835 Alexis Avenue, *Toledo.*

SHARPE, C. H. F. (J) care of Rev. H. F. Sharpe, *Claremont P. O., Jamaica, British West Indies.*

SHARON PRESSED STEEL CO., (Aff) *Sharon, Pa.*
Representatives:
Brunst, R. O., chief draftsman.
Reid, R. B., sales manager.
Zellmann, H. W., general superintendent.

SPRIGGS, CECIL T. (E S) student, Rensselaer Polytechnic Institute, *Troy, N. Y.*, (mail) 1995 15th Street.

STALNAKER, R. H. (A) assistant highway engineer, California Highway Commission, Forum Building, *Sacramento, Cal.*

STROEBEL, GEORGE ARTHUR (E S) student, Rensselaer Polytechnic Institute, *Troy, N. Y.*, (mail) 145 Eighth Street.

SVENSON, CHARLES W. (A) mechanical superintendent, Corbin Screw Corporation, *New Britain, Conn.*, (mail) 41 Park Terrace.

TERHUNE, JOHN E. (A) superintendent, Cox Brass Mfg. Co., *Albany, N. Y.*, (mail) 86 North Allen Street.

WILLIAMSON, JOHN EARL (E S) student in mechanical engineering, Rensselaer Polytechnic Institute, *Troy, N. Y.*, (mail) 2242 13th Street.

YOUNG, RAYMOND WILLIAM (E S) student, Yale University, *New Haven, Conn.*, (mail) Box 1294, Yale University.

WILLIS, REX C. (A) 734 Larkin Street, *San Francisco.*

Applicants *for* Membership

The applications for membership received between Dec. 24, 1921 and Jan. 16, 1922, are given below. The members of the Society are urged to send any pertinent information with regard to those listed that the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ADDAMS, CHARLES D., sales engineer, Bearings Co. of America, *Lancaster, Pa.*

BAYBUTT, JOHN W., draftsman, Selden Truck Corporation, *Rochester, N. Y.*

BUCK, ARTHUR V., repair shop foreman, Hahn Motor Truck Co., *Hamburg, Pa.*

BUGGIE, HORACE H., vice-president and general manager, Dura Mechanical Hardware Co., *Toledo.*

BUS TRANSPORTATION, 10th Avenue at 36th Street, *New York City.* (Affiliate membership).

CLARKE, JAMES RUSSELL, president, American LaFrance Fire Engine Co., *New York City.*

CLARKE, JAMES RUSSELL, JR., student, Cornell University, *Ithaca, N. Y.*

COOPER, M. S., vice-president, Asbestos & Rubber Works of America, Inc., *New York City.*

CRAIG, NORMAN, president and general manager, Light Alloys Co., *Cleveland.*

DAVIS, WILLIAM N., body engineer, Cadillac Motor Car Co., *Detroit.*

DUN, FAY A., instructor, Ohio State University, *Columbus, Ohio.*

EDDISON, W. BARTON, consulting engineer, 366 Madison Avenue, *New York City.*

GALLAUDET, EDSON F., chief engineer and chairman of board of directors, Gallaudet Aircraft Corporation, *East Greenwich, R. I.*

GOODWIN, G. J., instructor, Northeastern College, *Boston.*

GOUDY, CARL F., instructor, Pratt Institute, *Brooklyn, N. Y.*

HARDING, JOHN, JR., aviation mechanician, engineering division, Air Service, McCook Field, *Dayton, Ohio.*

HARPER, D. ROBERTS, 3RD, physicist, Bureau of Standards, *City of Washington.*

HOPKINS, PETER A., mechanical engineer, Penn Spring Works, *Baldwinsville, N. Y.*

JOHNSON, ANDREW F., instructor, Correspondence School for Automobile Body-Makers, *Gray, Me.*

JOHNSON, WILLIAM G., engineer, Commonwealth Motors Co., *Joliet, Ill.*

JOHNSTON, WILLIAM STANLEY, engineer, Motor Wheel Corporation, *Lansing, Mich.*

KEITH, ROBERT R., superintendent, International Harvester Co., *Chicago.*

KEPLER, ARTHUR R., sales engineer, Stewart-Warner Speedometer Corporation, *Chicago.*

LINDT, MAJOR JOHN H., United States Military Academy, *West Point, N. Y.*

MADELUNG, GEORG H., airplane designer, Glenn L. Martin Co., *Cleveland.*

MARVIN, CHARLES FREDERICK, student, Ohio State University, *Columbus, Ohio.*

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